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14. ABSTRACT
The U.S. Air Force has traditionally been a significant source of pilots for the major airline industries. For much of the 2000s, two wars and a sputtering economy aided in managing the attrition of Air Force pilots. But now, amid myriad converging factors, there is a large projected increase in major airline pilot hiring that resembles the late 1990s surge, in which the Air Force endured its largest loss of pilots since the post???Vietnam War pilot exodus. Using logistic regression analysis and focusing on active duty Air Force pilots in the first three years following completion of their initial active duty service commitment (ADSC), this dissertation predicts future pilot attrition given the estimated increase in major airline hiring and recommends several policies that the Air Force can implement to better weather an increase in attrition. This dissertation finds that attrition depends strongly on major airline hiring. Additionally annual attrition each year from 2015 through 2020 is expected to be above the 2002???2012 annual average. The impact of attrition is not spread evenly among the aircraft communities, and, even though mobility and fighter pilots account for the first- and second-highest proportions of future total attrition, respectively, it is the fighter community that is in the middle of a pilot shortage that is not likely to improve for at least the rest of the decade. For these reasons, this dissertation recommends re-instituting the 50 percent Aviator Continuation Pay up-front lump-sum option and increasing the yearly value to $30,000 in 2018 for fighter pilots following completion of their initial ADSC. Additionally, it is recommended that the Air Force index Aviation Career Incentive Pay to inflation for at least all active duty pilots with 6???13 years of aviation service. Enacting both measures would be greatly costeffective in terms of the training costs retained, and doing so would help in lowering pilot attrition in all communities, and especially in the fighter community.

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Dissertation

Predicting Active Duty Air Force Pilot Attrition Given an Anticipated Increase in Major Airline Pilot Hiring

Nolan J. Sweeney

RAND CORPORATION

Dissertation

Predicting Active Duty Air Force Pilot Attrition Given an Anticipated Increase in Major Airline Pilot Hiring

Nolan J. Sweeney

This document was submitted as a dissertation in June 2014 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Nelson Lim (Chair), Natalie Crawford, and Raymond E. Conley.

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Abstract

The U.S. Air Force has traditionally been a significant source of pilots for the major airline industries. For much of the 2000s, two wars and a sputtering economy aided in managing the attrition of Air Force pilots. But now, amid myriad converging factors, there is a large projected increase in major airline pilot hiring that resembles the late 1990s surge, in which the Air Force endured its largest loss of pilots since the post–Vietnam War pilot exodus. Using logistic regression analysis and focusing on active duty Air Force pilots in the first three years following completion of their initial active duty service commitment (ADSC), this dissertation predicts future pilot attrition given the estimated increase in major airline hiring and recommends several policies that the Air Force can implement to better weather an increase in attrition.

This dissertation finds that attrition depends strongly on major airline hiring. Additionally, annual attrition each year from 2015 through 2020 is expected to be above the 2002–2012 annual average. The impact of attrition is not spread evenly among the aircraft communities, and, even though mobility and fighter pilots account for the first- and second-highest proportions of future total attrition, respectively, it is the fighter community that is in the middle of a pilot shortage that is not likely to improve for at least the rest of the decade.

For these reasons, this dissertation recommends re-instituting the 50 percent Aviator Continuation Pay up-front lump-sum option and increasing the yearly value to $30,000 in 2018 for fighter pilots following completion of their initial ADSC. Additionally, it is recommended that the Air Force index Aviation Career Incentive Pay to inflation for at least all active duty pilots with 6–13 years of aviation service. Enacting both measures would be greatly cost-effective in terms of the training costs retained, and doing so would help in lowering pilot attrition in all communities, and especially in the fighter community.

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Chapter One: Introduction

The U.S. Air Force (USAF) has traditionally been a significant source of pilots for the major airline industries. For much of the 2000s, two wars and a sputtering economy aided in managing the attrition of Air Force pilots. But now, amid myriad converging factors, there is a large projected increase in major airline pilot hiring that will place added strain on the Air Force's ability to retain active duty pilots.

In the face of past increases in airline pilot demand, the Air Force was able to temper pilot attrition with a host of policies, including pay incentives and length of service changes. This time, the landscape is different. As such, this dissertation intends to illustrate the effect that looming increases in airline pilot hiring will have on active duty Air Force pilot attrition in the future, and also the effect that potential mitigating policy options might have on attrition, so that policymakers have a clearer understanding of the approaching situation. Additionally, this dissertation is structured from the pilot's perspective. That is, attrition is analyzed from the point-of-view of the pilot.

Organization

This dissertation is organized into five chapters. This chapter serves as an introduction to the topic of active duty Air Force pilot attrition. Chapter Two relies on literature reviews, previous studies, and interviews with former and current Air Force rated officers to paint the picture of historical pilot attrition since the Vietnam War. This is done to identify patterns, trends, and potential factors that affect a pilot's decision to stay in or leave active duty. The factors identified in Chapter Two are used in Chapter Three to develop a model of pilot attrition via a logistic regression for active duty pilots reaching the end of their initial commitment in the years 1995–2011. In Chapter Four, this model is used to predict active duty Air Force pilot attrition over the next six years and to identify policy options for dealing with pilot attrition. Finally, Chapter Five provides a brief conclusion, along with some parting thoughts on future areas for study.

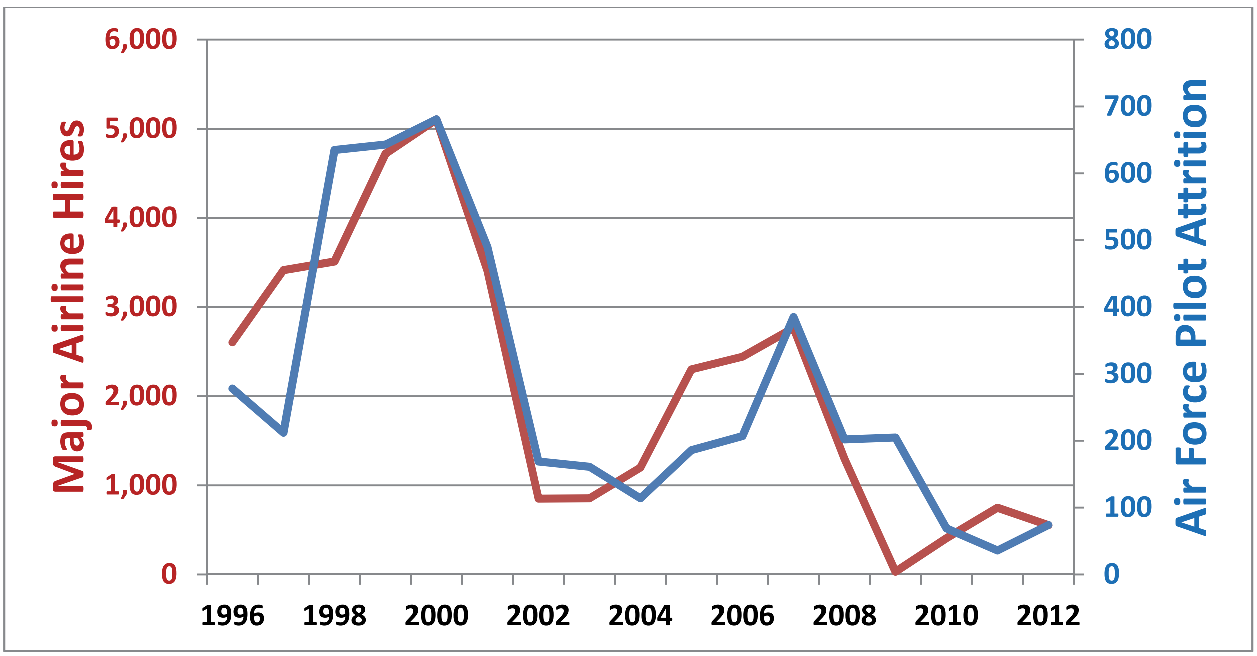
Overview of Air Force Pilot Attrition

While focusing on the pilot perspective is illuminating, it is, admittedly, unavoidably incomplete. There are three main parties actively involved with a vested interest in whether or not a pilot leaves the Air Force. Obviously, the pilot is one party. Pilots have invested a good portion of both their professional and personal lives—as well as their family's—in flying in the active duty corps. A decision to stay or depart affects the pilot's and his or her family's lives in myriad ways. Thus, this is not a decision that pilots take lightly, and unraveling the factors that have an effect on the decision remains one of the chief goals of this dissertation.

The Air Force is party number two. Although the Air Force has usually worked to retain large percentages of its pilot stock, there have been instances where it has done the opposite—actively drawing down its pilot numbers—to decrease the number of pilots. Additionally, the Air Force has targeted specific groups of pilots to either increase or decrease their attrition rates. The policies used by the Air Force are at times overt, as in the case of offering pilot bonuses paying upward of $25,000 per year for pilots committing to additional years of service, and at other times covert, as in the case when the Air Force simply does not intervene to influence or prevent pilots from leaving active duty.

The civilian airlines, specifically the major airlines, are the third party interested in the pilot's decision. Air Force pilots provide a perennial source of new hires to the airlines. Not surprisingly, periods of increased airline hiring often parallel periods of increased active duty Air Force pilot attrition, as is evidenced in Figure 1.1 for pilots in the first three years following completion of their initial active duty service commitment (ADSC) with less than 20 years of service (YOS).[1]

Figure 1.1: Major Airline Pilot Hiring Versus Air Force Pilot Attrition



Source: (Future & Active Pilot Advisors, 2013a; RAND Corporation, 2013)

It is at the fault line between these three valuations that a pilot ultimately makes his or her decision. Although this dissertation accounts for the Air Force's role in influencing attrition, it

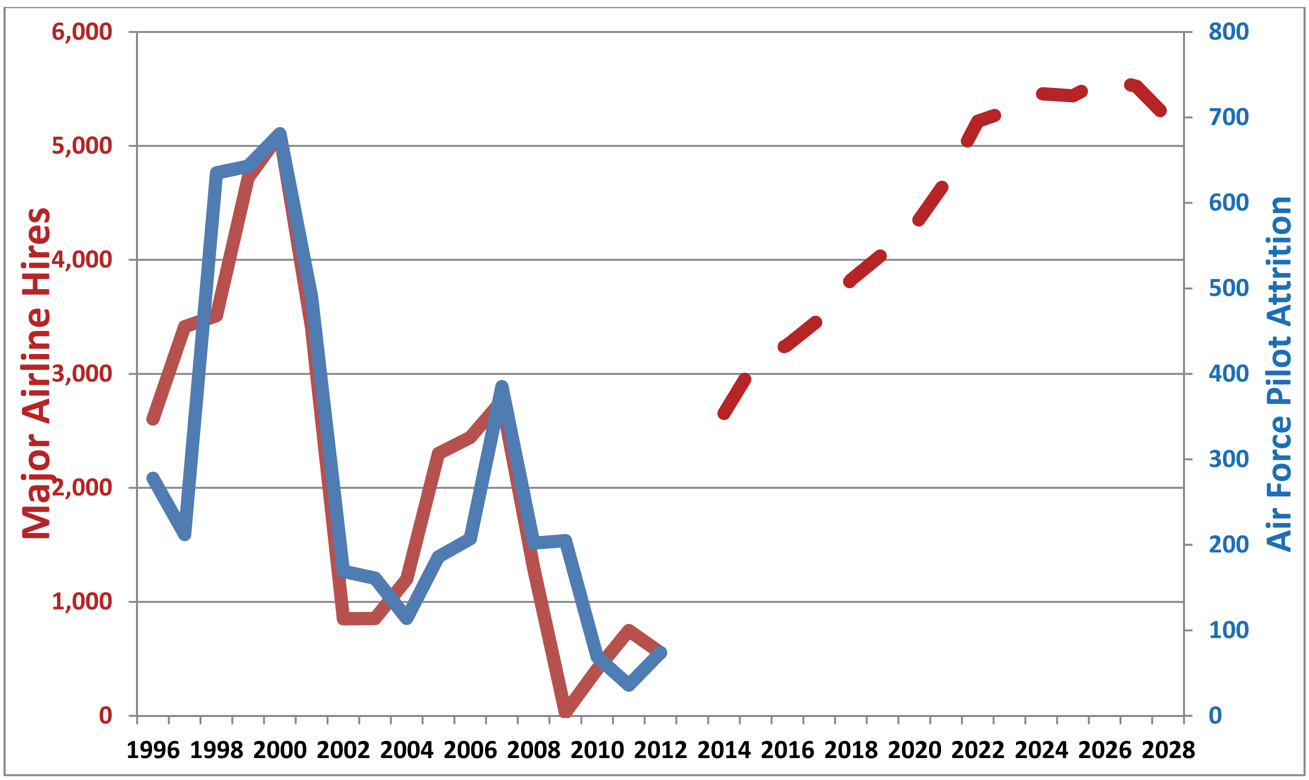
[1] This subsample of pilots—those within the first three years following completion of an initial ADSC and with less than 20 YOS—is the focus of analysis conducted in creating an attrition model. The reasons for focusing on this group are spelled out in Chapter Three.

does so through the lens of the pilot. This will become clearer in the discussion of the model. In reality, the pilot's decision can be thought of as the result of two components. First, the pilot's experiences and expectations place pressure—positive or negative—on the pilot to stay in or leave active duty. Second, airline hiring provides an escape valve. As the number of hires or the salary of commercial airline pilots increases, the escape valve widens, inducing more pilots to leave. As the Air Force works to reduce pilot attrition, the pressure may decrease, keeping pilots from departing for the airlines.

Fewer Pilots Available to Meet Rising Demand

Projected increases in major airline hiring, shown in Figure 1.2, prompted the writing of this dissertation. A myriad of factors are expected to converge in ramping up airline hiring in the next decade. Since active duty pilot attrition is often attributed to major airline hiring, it is important to tease out the contribution of airline hiring to attrition, in the context of all the other events and expectations that pilots experience and consider in making their decision.

Figure 1.2: Major Airline Pilot Hiring Versus Air Force Pilot Attrition, with Future Estimated Major Airline Pilot Hiring (shown by the dashed red line)

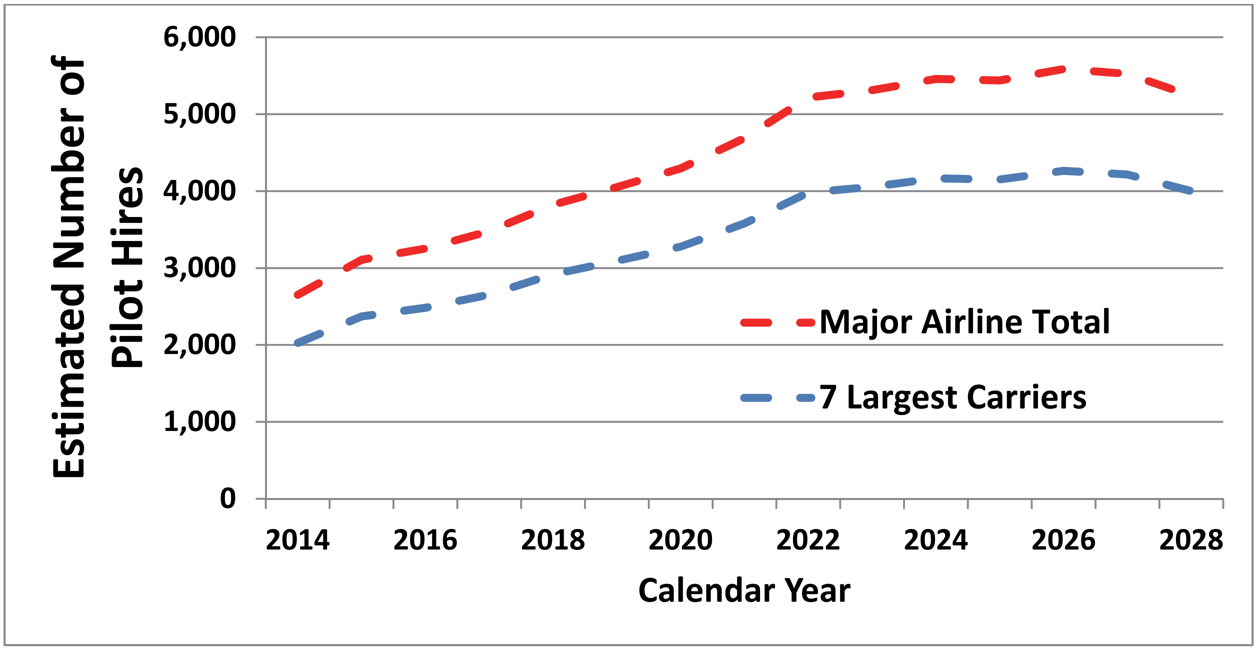


Source: (Future & Active Pilot Advisors, 2013a; RAND Corporation, 2013)

Major airline hiring has remained relatively depressed since 9/11. It picked back up briefly around 2007, to almost 3,000 hires per year, before the global economy entered a recession and

major airline hiring plummeted to an abysmal 30 major airline pilots hired in 2009. The recovering economy, a wave of major airline pilot mandatory retirements, and two new laws raising minimum flying hours and crew rest requirements are set to cause a dramatic increase in the number of pilots the major airlines will hire. As shown in Figure 1.2, major airline hiring is projected to increase, almost monotonically, in the next decade and a half from 2,000 hires per year to well over 4,000 hires per year. This undoubtedly will be felt by active duty Air Force pilots eligible to leave the corps.

Figure 1.3: Future Estimated Major Airline Pilot Hiring



Source: (Future & Active Pilot Advisors, 2013a)
Note: These seven largest U.S. air carriers (Alaska, American Airlines and US Airways, Delta and Northwest, FedEx, Southwest and AirTran, United and Continental, UPS) accounted for 76% of major airline hires in years 1990–2012. Total estimate is derived from these seven carriers' totals.

U.S. airlines are predicting a surge in airline pilot hires in the next decade, but even with this surge they are also predicting that they will not be able to keep pace with the even higher increase in demand for airline pilots. The increase in airline pilot demand is being fueled by a few main factors. Each of these forces is not new, and taken separately they represent problems that have already been faced and overcome during the short history of commercial flight. But taken together, this looming set of factors presents an enormous challenge for commercial airlines.

First, thousands of airline pilots are fast approaching the Federal Aviation Administration (FAA)–mandated retirement age of 65, and more than half of all airline pilots are above the age of 50 (Kennedy, 2012). In response to thousands of airline pilots bumping up against the

mandatory retirement age of 60 years back in 2007, Congress passed the "Fair Treatment for Experienced Pilots Act," which allowed pilots to stay on until 65 years of age (Fair Treatment for Experienced Pilots Act, 2007). In effect, this act delayed the mandatory retirements five more years, which explains why the impending problem in 2007 is now the impending problem several years later. While increasing the retirement age has not led to more accidents or incidents involving pilots ages 60–65, it is an exhaustible strategy for delaying pilot retirements (United States Government Accountability Office, 2009).

Second, a new regulation went into effect August 2013 requiring all commercial airline pilots to have a minimum of 1,500 flying hours (Kaufman, 2012). While airline captains were already required to have 1,500 flying hours, first officers (i.e., co-pilots) were previously required to have only 250, so the new regulation increases this requirement six-fold (The Associated Press, 2012). An Air Force pilot that is separating is likely to have met the 1,500-hour requirement, or nearly so, making recruitment of Air Force pilots a likely avenue for filling co-pilot jobs.

Third, there is increasing demand for more airline pilots within the United States as the economy improves and expands (Larter, 2011).

Fourth, a trend has begun in which fewer U.S. students are interested in becoming commercial pilots. Up until the mid-1990s, U.S. carriers hired 90 percent of their pilots from the military, with the remaining coming from civilian training (Duggar, 2009). But, as civilian salaries began to slump, military pilots stayed longer in their services or found higher-paying civilian careers (Wien, 2011). Younger pilots entering on the civilian side filled whatever spaces were available and mostly found themselves in regional airline jobs making under $30,000 per year. This low pay drove many interested potential commercial pilots toward other careers (Jones, 2011). The University of North Dakota, an Aerospace Carnegie Doctoral Research Institution, found that each year since 2003 aviation interest has dropped among high school juniors, the exact grade in which students make college decisions based on the type of career they want to pursue (Lovelace, 2008). In addition to low pay, the university also attributed the loss of interest to recent airline distress, bad press, increasing schooling and training costs, increasing debt among students and their parents, the tightening of the student loan market, and parents being financially less able to help (Lovelace, 2008).

Fifth, there is a rapid growth of air travel in Asia (which is on pace to exceed North America as the largest air market in the world) that is also increasing worldwide demand for airline pilots (Yogalingam, 2013). This may contribute to the number of pilots that U.S. air carriers may have to hire in order to remain competitive across the globe. Worldwide demand can also siphon off pilots traditionally bound for U.S. jobs. Boeing has forecasted a worldwide need for 23,300 new commercial pilots per year until at least 2029 (Duggar, 2009). Recently, this projection has been increasing, with developing economies such as China's—which demands an additional 3,200 pilots per year—leading the way (Hashim, 2012). With such high demand, there are financial incentives for American pilots and students who are looking to fly and are willing to take a job with a foreign airline. Air China is paying students a $4,000 per month living allowance during

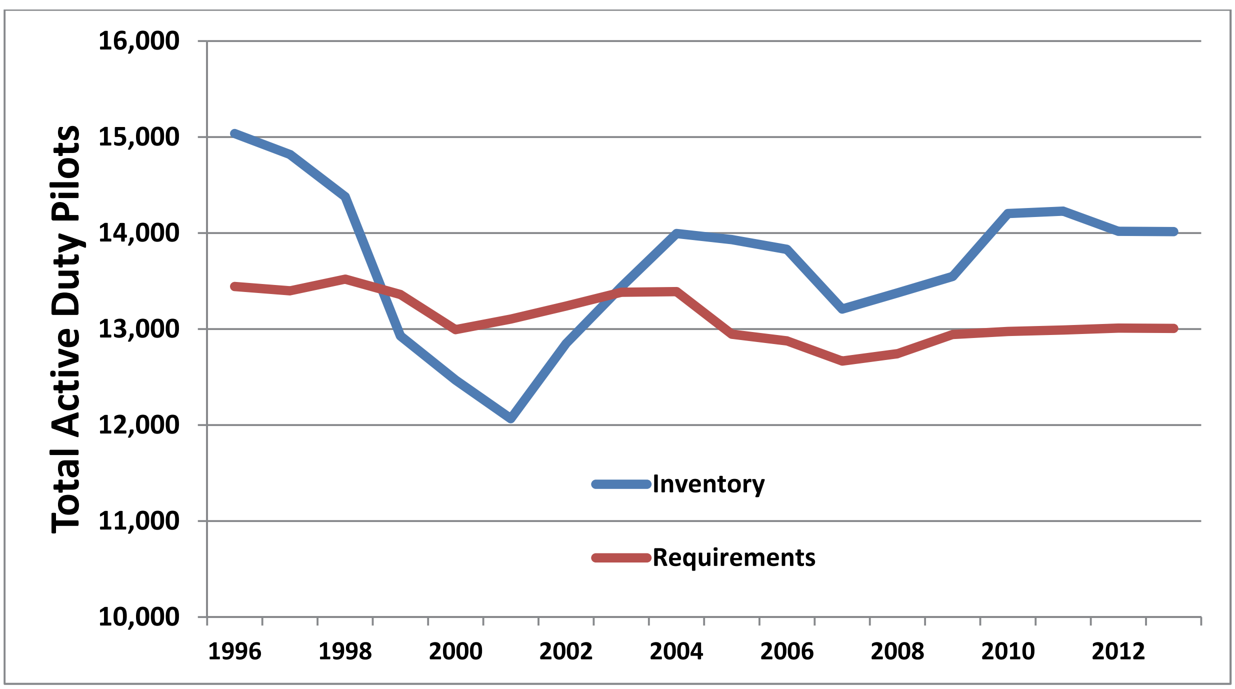
training, and then after training pay increases to $12,500 per month in addition to the $4,000 monthly living allowance (Wasinc International, 2013).

Together, these factors show that the eligible airline pilot pool is shrinking even as the worldwide demand for pilots is increasing. This presents a problem for the Air Force, which has been a perennial source of pilots for the airlines. For example, 45 percent of Southwest Airlines' 6,100 pilots are from the military, and the majority of them are former airmen (Larter, 2011). In the fact of the looming airline pilot shortage, it is very likely that airlines may attempt to fill their vacant seats by luring Air Force pilots out of the Air Force. Thus, the approaching situation will likely negatively affect Air Force pilot retention rates. Understanding the magnitude of this problem and identifying policy options to address it is the objective of this dissertation.

Active Duty Air Force Pilot Inventory Versus Requirements

The Air Force is concerned with major airline hires to the extent that they affect the pilot manpower balance. There exists a constant tension in trying to balance the inventory of pilots with the required number of pilots needed to fulfill the mission of the Air Force. This is often illustrated using red line/blue line charts, such as the one shown in Figure 1.4, in which the red line shows requirements and the blue line shows inventory.

Figure 1.4: 1996–2012 Active Duty Air Force Pilot Annual Manpower Balance



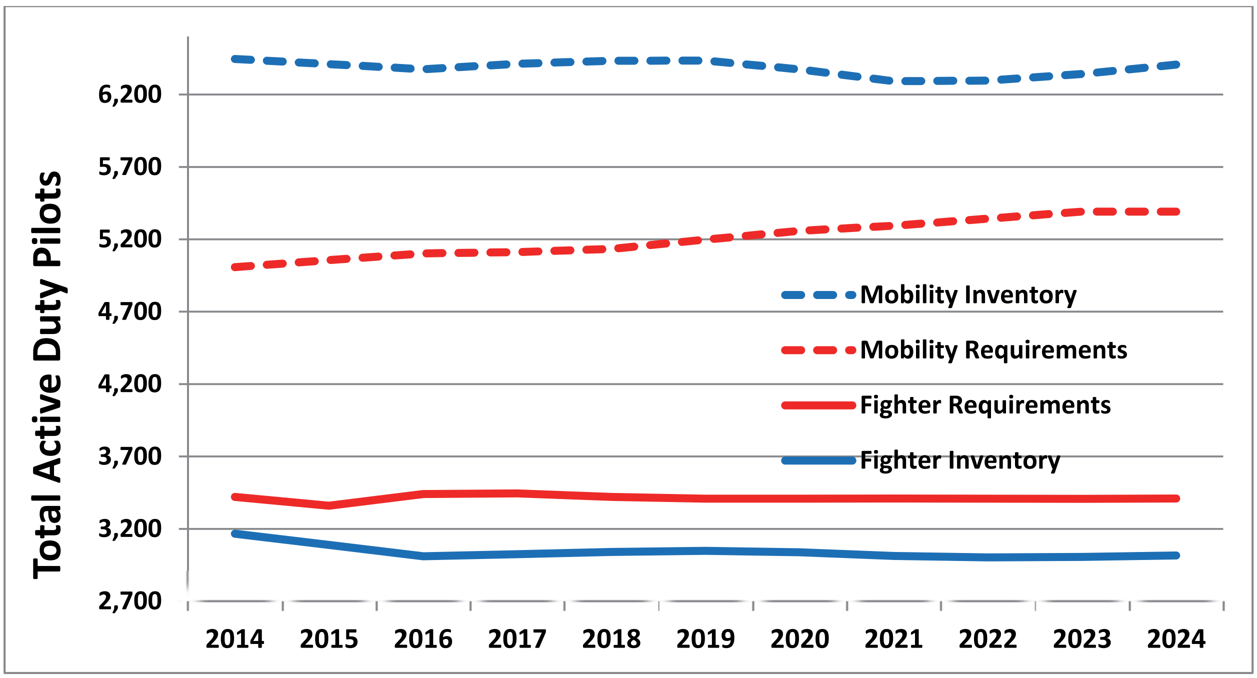
Source: (Bigelow, 2013a; Bigelow, 2013b); (Bigelow, 2014).

The Air Force came into the mid-1990s with an active duty pilot surplus (it had more pilots in its inventory than the Air Force mission required). However, a large exodus of active duty

pilots to major airline jobs over the next few years caused inventory numbers to plummet to the point that the Air Force had a pilot shortage from 1999 to 2003. Since 2003, the Air Force has maintained a total active duty pilot surplus. However, that surplus has not been evenly distributed among all of the various aircraft communities.

As shown in Figure 1.5, much of the projected pilot surplus exists within the mobility community. The fighter community, on the other hand, is in the midst of a shortage of fighter pilots, one that is already projected to not improve in the future, whether or not attrition rates rise due to increases in major airline hiring. Moreover, the fighter community is not well poised to withstand any increase in attrition that might further exacerbate their persistent shortage of active duty fighter pilots.

Figure 1.5: Estimated Future Active Duty Air Force Mobility and Fighter Pilot Annual Manpower Balance



Source: Bigelow, 2013a; Bigelow, 2013b; Bigelow, 2014.
Note: Not including unmanned aircraft pilots.

The projections shown in Figure 1.5 do not consider major airline hires when generating inventory numbers. Instead, pilot attrition is calculated using the average annual bonus take rate for each aircraft community from 2006 to 2010 (Bigelow, 2014). The bonus will be discussed in much greater detail later, but it is a monetary incentive that pilots may accept upon completion of their initial ADSC in exchange for an additional service commitment. Bonus take rates appear

greatly influenced by major airline pilot hiring.[2] The five years from 2006 to 2010 averaged 1,389 major airline pilots hired each year. Major airline hires are estimated to be more than twice that number in 2015, increasing to more than three times that number by 2020. This may be cause for concern since the inventory projections in Figure 1.5 relied on average take rates of above 50 percent for each community taken in a time span with relatively low numbers of major airline hires. Thus, it may be likely that when hiring increases, the model relied on for the projections in Figure 1.5 will have underpredicted attrition, leading to an overestimated number of pilots in the inventory. If this is true, then the already expected pilot shortage in the fighter community will only get worse.

Research Questions

This dissertation attempts to address and answer the following research questions:

1. Historically, how has Air Force pilot attrition responded to changes in airline hiring?
2. How might Air Force pilot levels change during this new period of hiring, and why?
3. What mitigating policies might be applied?

The first research question is the subject of the next chapter, in which a qualitative review of pilot attrition since the Vietnam War provides insight into the various factors—major airline hiring among them—that affect pilot attrition. This insight then guides the creation of an attrition model that uses historical data to generate the impact of those factors on pilot attrition. These results are then used to predict future pilot attrition, which helps answer the second research question. Last but not least, the model is used to test different mitigating policies in order to help answer the third research question. Thus, these research questions serve as the framework for the research and analysis that follows.

[2] One of my previous attrition models operated in two stages. The first stage predicted which pilots would take the bonus, and the second stage predicted attrition for the pilots who did not take the bonus. While this approach was abandoned, one of the key take-aways from this approach confirmed what many others had said about major airline pilot hiring: that it is a key determinant of the bonus take rate.

Chapter Two: Historical Review of Air Force Pilot Attrition

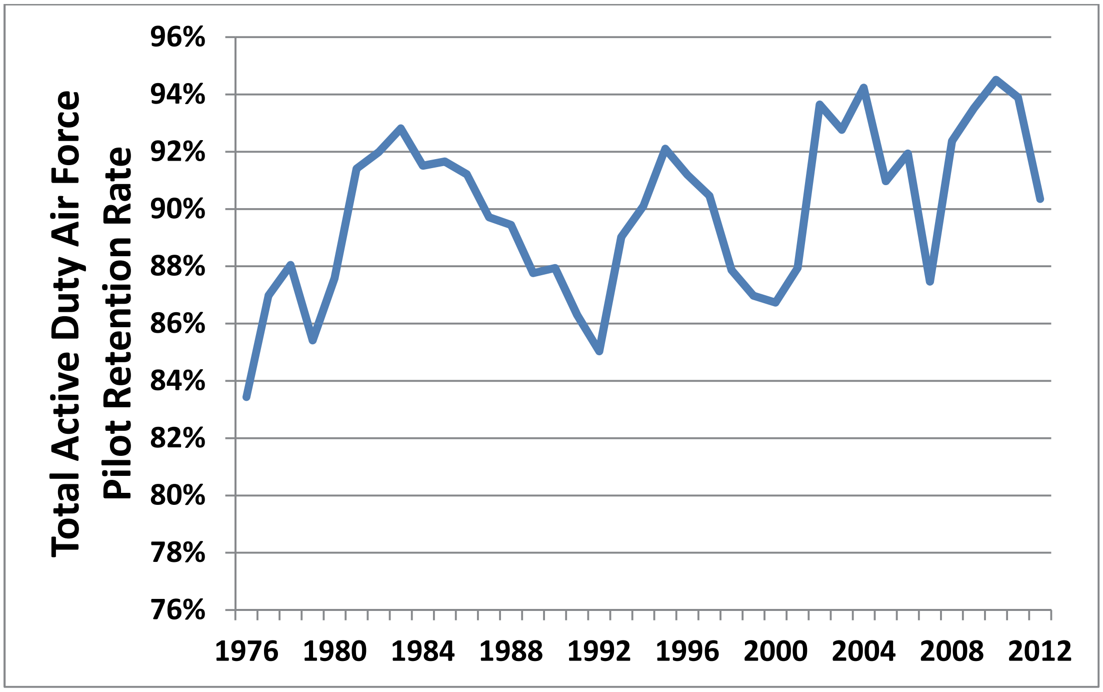
Introduction

Before beginning any detailed discussion of Air Force pilot attrition/retention rates, it is helpful to remember that the rates are just one number representing the product of a very complicated set of circumstances. First, they measure at an aggregate level the result of many individual decisions to stay in or leave the Air Force. One officer's decision may have come about in an entirely different manner than another officer's decision. Second, the Air Force has worked to both increase and decrease attrition/retention rates using a variety of methods to incentivize active duty pilots to stay or to leave. Attrition/retention is just one lever the Air Force attempts to maneuver in order to manage pilot inventory. Nonetheless, the intention of this chapter is to uncover factors influencing individual attrition decisions that are consistent at the aggregate level and across the years. Doing so will not only contextualize the historical pilot retention rates presented below, it will also serve as guidance toward predicting active duty Air Force pilot attrition into the future. Lastly, any mention of attention/retention is to be interpreted as active duty Air Force pilot retention/attrition unless otherwise specified.

Retention History

Figure 2.1 shows the annual simple retention rates for *all* active duty Air Force pilots dating back to 1976. During this time, the Air Force cycled through five significant eras that characterized its retention rates, and the organization is currently at the beginning of a sixth era that will last for at least the next few years. The simple retention rate graphed in Figure 2.1 shows the percentage of all active duty pilots that stay each year. This number includes both pilots who are ineligible to leave due to service commitments and those who are eligible to leave or retire. Since such a large population is ineligible to leave, a change of a few percentage points in the simple retention rate represents a retention difference of a significant number of eligible pilots.

Figure 2.1: Annual Active Duty Air Force Pilot Retention Rates, 1976–2012



Source: (RAND Corporation, 2013)

With U.S. military involvement in Vietnam ending in 1973, the Air Force entered the post-Vietnam era (1974–1980), characterized by its first "hollow force" period later that decade. Throughout the era, pilot retention rates were no higher than 88 percent. The year 1981 marked the start of the Cold War buildup era (1981–1990). During the first seven years of the era's significant military buildup, retention rates were above 90 percent. With the Soviet Union collapse within sight by the end of 1988, the buildup began coming to a close. Retention rates in 1989 and 1990 were back down to around 88 percent.

The post–Gulf War One era (1991–1997) effectively began after Operation Desert Storm, and ushered in a decade defined by USAF operations and deployments around the globe. During this time, retention rates climbed back from a low of 85 percent in 1992 to above 90 percent in 1994, hovering above 90 percent for the remainder of the era. Pilots in this era were deployed frequently. By the end of 1997, retention rates began to drop, and the Air Force entered its second "hollow force" period, with retention rates staying below 88 percent through most of 2001.

After the Cold War drawdown in the pilot force, the remaining pilots found themselves working more than they had ever worked before. Then, in the late 1990s, the airlines began hiring feverishly, luring away experienced Air Force pilots. A spiral developed whereby the remaining pilots had to carry more of the load, making them overworked and providing an increased impetus to join the airlines. The more experienced pilots that left, the more pressure it put on others to leave. Then in the post-9/11 era (September 2001–2013), a decrease in hires

combined with a bolstered sense of patriotism and duty helped propel and hold retention rates well over 90 percent in every year except 2007 (Callander, 2006; Hebert, 2003; Future & Active Pilot Advisors, 2013a). It is likely that in 2008–2012 retention rates would have declined had the world not entered into the Great Recession. Instead, a downtrodden economy contributed to the persisting high retention rates.

We are currently at the start of a new era, one characterized by a recovering economy and, more to the point, a recovering airline industry. While the Air Force has clearly experienced changes to its pilot retention rates in the past, it remains to be seen exactly what affects this new era will have on an individual pilot's decision to stay in or leave the Air Force.

Post-Vietnam Era (1974–1980)

The end of the draft in 1973 signaled the start of the post-Vietnam era (Lt Col Daniel L. Cuda, 1994). As a whole, the Air Force was in rough shape after the end of the Vietnam war (Henderson, 1990). If personnel did not notice the degradation of the force, they definitely felt the degradation of their pay. After military base pay had increased by 61 percent in nominal terms between 1969 and 1973, "salaries did not keep up with high levels of inflation during the remainder of the 1970s and fell progressively further and further behind the cost of living" (Andrew Feickert; Stephen Daggett, 2012). By 1980, inflation had eroded the value of base pay to almost 80 percent of its FY1972 value (*National Defense Budget Estimates*, FY2012).

It is not surprising then, that when airline hiring increased in 1977 from 1,000 the year before to 4,000, the probability of a pilot in his sixth year of service staying five more years dipped to an all-time record low of 25 percent (Chapman, 1997a). It seemed that the Air Force would face a tough stretch over the next few years in retaining its pilots. Fortunately for the Air Force, in the years after the 1978 Airline Deregulation Act there were "a lot of [airline pilot] furloughs, the airlines stopped hiring. …Not so curiously, our [pilot] retention went to pretty high levels," stated at the time Brigadier General John F. Regni (Chapman, 1997a). Those higher-than-expected retention levels for that decade masked the Air Force's underlying descent into becoming a "hollow force" for the first time in its 30-year history.

The phrase "hollow force" refers to a force that appears mission ready on paper but, in reality, is not mission-capable due to shortages of personnel and equipment and deficiencies in training (Andrew Feickert; Stephen Daggett, 2012). The infamous 1979 "Dear Boss" letter penned by Captain Ron Keys to the Tactical Air Command commander, General Wilbur Creech, captured the frustrations and dissatisfactions of many Air Force pilots of that era. As the Air Force drew down in personnel (from 138,324 officers in 1968 to 95,228 by 1978), it did not draw down in tasks, and the remaining pilots were forced to do more work with fewer resources ("Air Force Active Duty Strength," 2013). Moreover, Captain Keys had become frustrated that the rest of the Air Force had "figured out the fundamental fact that you can't do more with less—you do less," while pilots would lose their jobs if they let the drawdown negatively impact their operations (Anderegg, 2001). As a result, Keys wrote that the remaining pilots were stretched

thin, working long hours with the only accolade being “no punishment,” and that the underperforming force valued giving the answers superiors wanted to hear as opposed to the correct answers. This environment of being underappreciated and overworked, coupled with the internally propagated false pretense that the force was functioning normally, gave rise to a group of cynical and exhausted pilots looking for a career outside the Air Force.

By 1980,

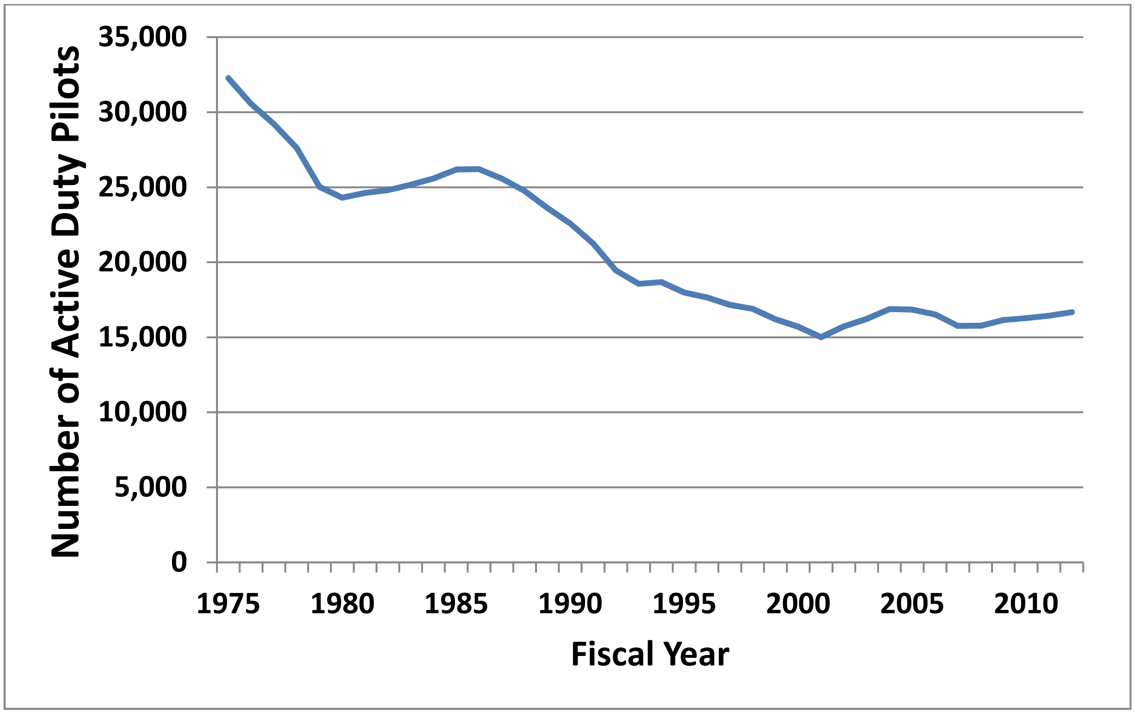
> the Air Force was ailing. Its bombers and ICBMs were outdated, too many of its fighters were holdovers or hangar queens, its airlifter and tanker fleets were woefully short of capacity and versatility, its training suffered from severe constraints on flying time, and it had to struggle to recruit and retain good people. (Canan, 1986)

The attrition of Air Force pilots would have likely been worse at the end of this era had it not been for the airlines’ financial struggles and their low pilot hiring.

Cold War Buildup Era (1981–1990)

The effects of inflation on poorly adjusted military base pay continued into the next era. Pay raises of 11.7 percent in 1980 and 14.3 percent in 1981 still found base pay at less than 90 percent of its FY1972 real value (Andrew Feickert; Stephen Daggett, 2012). However, these pay raises were part of a larger Air Force effort in the early 1980s to reverse the “hollowing” of its force that had begun in the late 1970s (William J. Dalonzo, 1999). As shown in Figure 2.2, the Air Force of the early 1980s reversed its hemorrhaging of pilots and increased its active duty pilot numbers through 1986.

Figure 2.2: Total Annual Active Duty Air Force Pilot Inventory, 1975–2012



Source: (RAND Corporation, 2013).

The "hollow force" stresses stemming from having too few pilots were no doubt partially alleviated by the increase of pilots in the 1980s. Moreover, the 1980s also found pilots back in the air increasing their yearly total flying hours, as compared with the "hollow force" period (RAND Corporation, 2013).

The increasing pay, increasing number of pilots, and increasing flying hours worked to increase and stabilize pilot retention. By 1986, the positive state of the pilot force was felt Air Force–wide: "The Air Force is in good shape. Its leaders are convinced that it is more capable—better manned, trained, and equipped—than at any time in its history, bar none" (Canan, 1986). This sanguine outlook toward Air Force capabilities would not last, however, as the Cold War buildup gave way to the Cold War drawdown.

The lessons of the late 1970s were not forgotten, and when the Department of Defense (DoD) began to consider the drawdown that would likely occur in the next few years, it did not want to endure another "hollow force" period in which it experienced a depleted pilot stock. DoD proposed a new aviator bonus program for FY1989 and, due to congressional concern over a need to comprehensively analyze aviator management and compensation initiatives, initiated a Department of Defense Aviator Retention Study on June 22, 1988 (*DoD Aviator Retention Study*, November 1988). The survey found that roughly 64 percent of fixed-wing pilots entered active duty intent on staying for a full career. Some of the remaining pilots admitted entering into service with a limited knowledge of the military lifestyle and remained undecided in their career

intent, and a smaller percentage entered service only as a stepping-stone for later employment in the airline industry. Most importantly, the survey found that officers' experiences during their careers influence their decision to stay or leave the service. These findings translated into rated management policies—specifically with the Air Force using monetary incentives to offset some of the negative experiences—during the coming drawdown in forces (William J. Dalonzo, 1999).

At the time of the survey, pilot retention dipped below 90 percent, and pilots in the survey attributed some of this to the "recent drawdown and [a] tight fiscal environment" (Dale W. Stanley III, 2012). In 1989, the "take rate" for the Aviation Continuation Pay (ACP) was 67.5 percent of all eligible pilots (Chapman, 1997a). This bonus pay is offered to pilots at the completion of their ADSC, and entails an additional commitment should the pilots take it. Typically, 90 percent of pilots who do not take the ACP leave the Air Force within two years ("Pilots," 1997). It can be thought of as a potential leading indicator of pilot attrition. By 1990, the ACP take rate had fallen by 30 percent to 37.5 percent (Chapman, 1997a). But not all of this was bad at the time, as pilot requirements were cut from 22,300 in FY89 to 15,207 over the next five years (Ballard, 1998). At the end of the era, the Air Force was left trying to balance a total force drawdown in numbers without losing an invaluable portion of mid-level pilots approaching the end of their current ADSC.

Iraq touched off Gulf War One by invading Kuwait on August 2, 1990. The need for Air Force pilots changed from one of simple force management to one of looming operational necessity as five days later the U.S. initiated Operation Desert Shield and built up its forces in Saudi Arabia and the surrounding area (Finlan, 2003). This need prompted the Air Force to implement a Stop-Loss on September 17, 1990, changing personnel separation or retirement dates that were between October 2 and December 31, 1990, to January 1, 1991 (Cohen, 2012).

Post–Gulf War One Era (1991–1997)

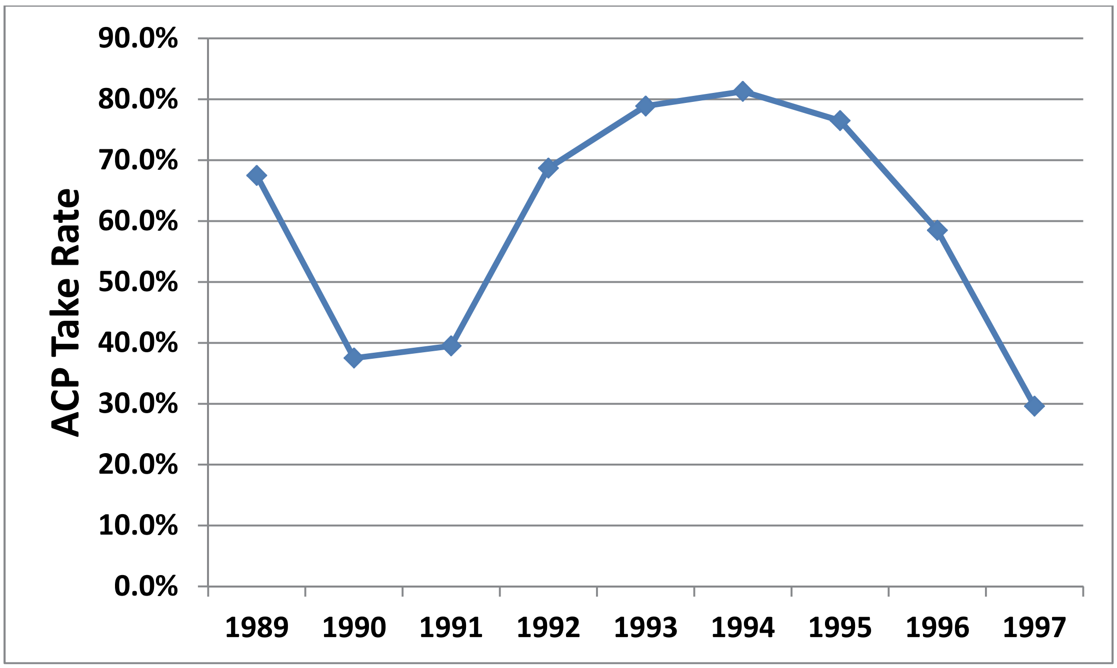
Between September 1990 and January 1991, the Air Force continually revised its Stop-Loss implementation, and by the time Operation Desert Storm kicked off on January 17, 1991, with an Air Force bombing campaign, Air Force pilots were under an indefinite Stop-Loss given the uncertainty of the evolving Gulf Crisis (Cohen, 2012; Finlan, 2003). By the end of February, Desert Storm had officially ended, and Stop-Loss began being rolled back for Air Force pilots. Four months later, at the end of June 1991, Stop-Loss was no longer being used on pilots en masse (Finlan, 2003).

The momentary halt in pilots fleeing active duty due to Stop-Loss was short-lived, as the Cold War drawdown's pilot exodus returned. Even with the nine-month Stop-Loss, close to 30 percent of eligible pilots left the Air Force in 1990, and close to 35 percent left in 1991 ("Pilots," 1997). This number climbed a few more percentage points, peaking in 1992 as the last surge of pilots that intended to leave the force around the Gulf War did so ("Pilots," 1997).

After this last wave of pilots left active duty, the Air Force experienced a stable next few years of pilot retention as the ACP take rate climbed from about 40 percent in 1991 to a high of

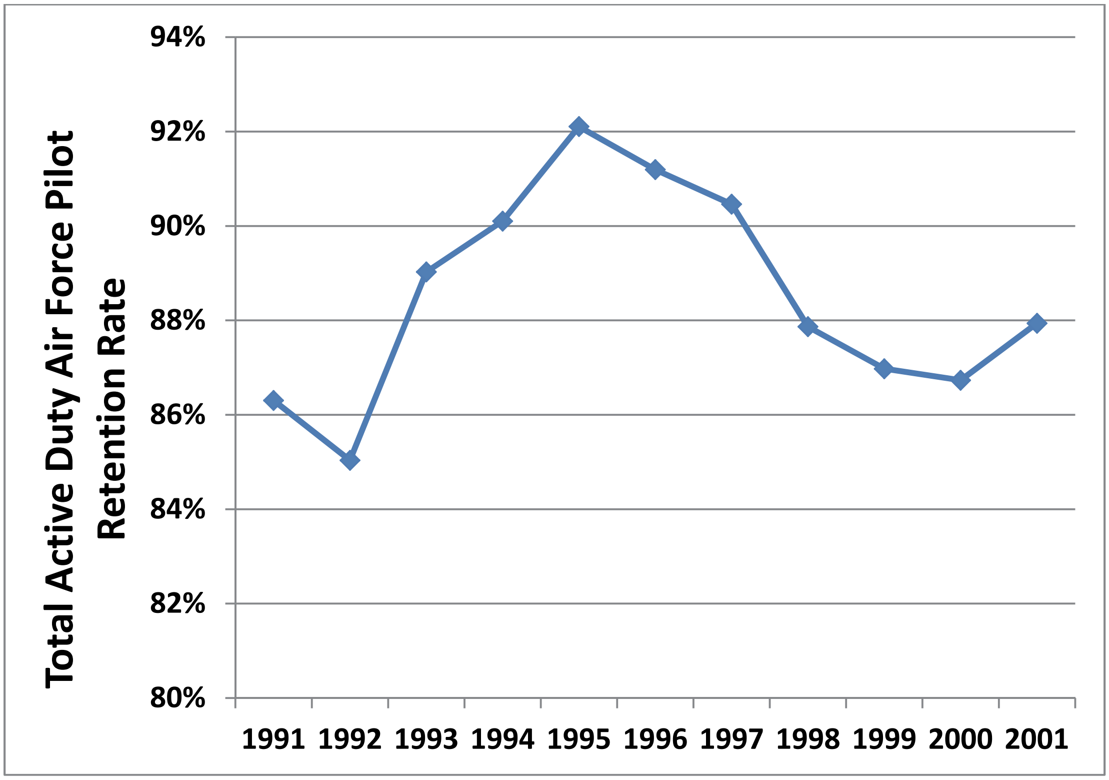
81 percent by 1994 (Figure 2.3). This hinted that pilot retention would be higher for at least the next two years. Similarly, after the percentage of eligible pilots leaving the Air Force peaked in 1992 above 35 percent, 1993 saw close to 25 percent of eligible pilots leaving and in 1994 less than 15 percent of pilots left active duty ("Pilots," 1997). This encouraging forecast rang true, as pilot retention for all active duty pilots remained above 90 percent from 1994 to 1997 (Figure 2.4). This is counter to what was predicted in 1989 and 1990, when it seemed that a looming airline pilot hiring frenzy would deplete the Air Force's stock of its pilots; instead, the Gulf War drove oil prices up and led to airlines furloughing their recently hired pilots (Ballard, 1998).

Figure 2.3: Annual Initial ACP Take Rate, 1989–1997



Source: (Chapman, 1997a)

Figure 2.4: Annual Active Duty Air Force Pilot Retention Rates, 1991–2001



Source: (RAND Corporation, 2013)

The Air Force Personnel Rated Force Policy Division did not believe rated retention was a major problem in 1996 (Callander, 1996). The past few years' meager airline performances had translated into fewer pilots being hired (Callander, 1996). Additionally, the recent implementation of ACP—a bonus now paying pilots up to $12,000 per year for staying past their initial ADSC—was also being credited by the division in helping pilot retention (Callander, 1996). This pay was in addition to another flight pay, the Aviation Career Incentive Pay (ACIP), which at that time peaked at $650 per month for officers with between 6 and 18 years of aviation service.

By 1996, the long Cold War pilot drawdown had almost fully tapered off, and the manner in which the Air Force had been reducing its pilot numbers began setting the stage for another large future wave of pilots leaving the force. Instead of reducing pilot numbers across the ranks during the drawdown, the Air Force curtailed its pilot production—producing 1,000 pilots in 1994 and 1995 combined, compared with 1,500 to 2,000 pilots per year throughout the 1980s—and allowed its pilot force to become mid-level officer heavy (Callander, 1996; Rostker, 2013).

Table 2.1: Active Duty Air Force Pilot Rank Proportions, 1986 Versus 1995

Rank	1986 Share	1995 Share
O-1	5%	0.50%
O-2	15%	6.50%
O-3	38%	58.30%
O-4	25%	17.70%

Source: (Callander, 1996)

In looking at the conditions for a large pilot exodus, essentially two things are required. First, there have to be a large number of pilots eligible to leave. Second, the pilots have to want to leave. The Air Force thus found itself in the precarious position of having more than half of its pilot force eligible, or approaching eligibility, to leave the active force. As for the second condition, the 1996 ACP take rate fell to 59 percent and the 1997 rate to 32 percent ("Pilots," 1997). So while there was yet to be a trigger for a major exodus, the pilots were definitely well situated and able to exit should major airline conditions ripen.

In 1997, optimism toward pilot retention gave way to realistic worries over just how bad retention was about to become, as the conditions indeed began to ripen for a large mass departure of pilots. In that year, the percentage of eligible pilots leaving climbed back to 1992 levels of about 35 percent ("Pilots," 1997). But unlike in 1992, the ACP take rate did not increase, meaning that pilots in the coming years could continue to leave, and this worried the Air Force since airlines were hiring and had more than enough capacity to hire all the eligible *military* pilots in the next few years ("Pilots," 1997). Table 2.2 shows that, other than pilots flying trainers, pilots flying airframes similar to the airliners had the lowest ACP take rates.

Table 2.2: ACP Statistics by RDTM Code, 1997

Type of Airframe	Accept ACP/Eligibles	ACP Take Rate
Fighter	49/152	32.2%
Bomber	14/37	37.8%
Strategic Airlift	41/158	25.9%
Theater Airlift	27/76	35.5%
Tanker	22/96	22.9%
Helicopter	7/15	46.7%
Trainer	0/7	0.0%
Total	160/541	29.6%

Source: ("Pilots," 1997).

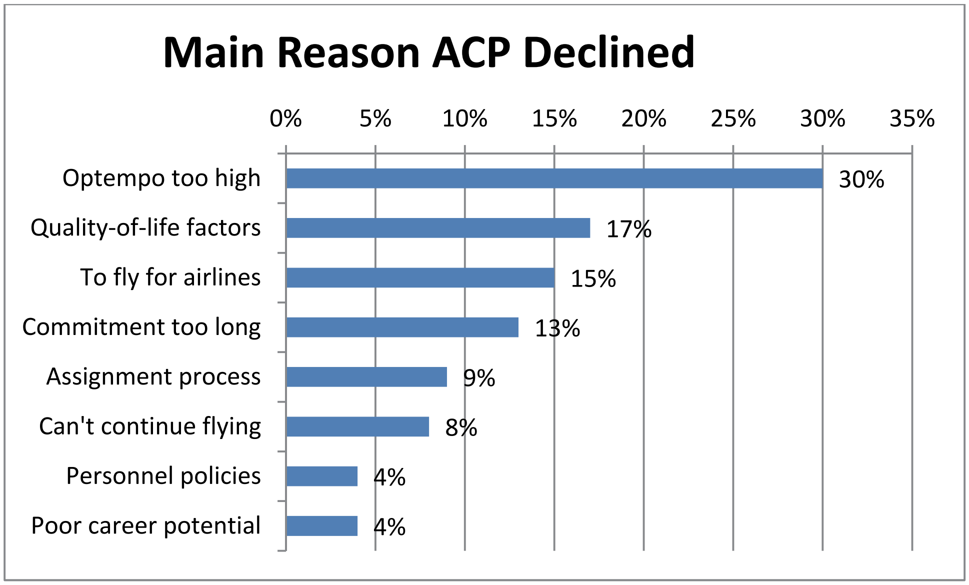
In February 1997, the USAF Chief of Staff, Gen Ronald R. Fogleman, addressed the Senate Armed Services Committee over what he called the first stages of a major pilot drain being caused by a high operations tempo, the eroded value of pilot pay, and high-paying jobs outside of the military (Chapman, 1997a). The USAF Deputy Chief of Staff for Personnel, Lt Gen Michael D. McGinty, went on to highlight how leading indicators did not bode well for pilot retention (Chapman, 1997a).

Two months later, the Air Force held a pilot retention summit for USAF leaders to discuss and consider the recent uptick in pilot complaints—revolving mainly around the high operations tempo and reduced quality of life—as a way of getting ahead of what many feared as the start of a long period of low retention (Chapman, 1997a). During this summit, leaders also expressed worry over the leading indicators they typically use to assess future pilot retention: The 6–11 year cumulative continuation rate, which gives the probability that a pilot with 6 YAS will still be in the Air Force in five years, had fallen nine percentage points in one year and was continuing to decline in projections; the ACP take rate for that year was holding at a disappointing 39 percent; separation requests had increased 51 percent in the past year; and after experiencing a relative calm in airline hiring the past few years, the airlines began an aggressive hiring resurgence in 1996 (increasing hires by 40 percent from 1995) (Chapman, 1997a).

While this last indicator generated the most concern among Air Force leaders (Brig Gen Regni stated in a 1997 interview that there is a delay between an increase in airline hiring and a decrease in pilot retention of 21 months), only 15 percent of pilots who declined the bonus in FY1997 stated that their main reason for leaving was to fly in the airlines (Chapman, 1997a).

Even though the drawdown had ended, the Air Force's mission in the 1990s "…changed from defending the world against communism to fighting two major regional conflicts." (Martin, 1999). In fact, these regional conflicts changed the number and placement of deployments the Air Force required in its new role conducting military operations other than war (MOOTWs), such as disaster relief, humanitarian assistance, nation-building, and peacekeeping operations: Between 1916 and 1988, the United States conducted four MOOTWs, while between 1989 and 1996 the Air Force was involved in nine (Vick, 1997). This re-characterization of the Air Force as an expeditionary force meant that the remaining pilots left after the drawdown were themselves stretched thin, being deployed on average four times as much as any time during the Cold War—a new level of operations tempo that was much higher than pilots had expected and, unfortunately, according to Brig Gen Regni, was here to stay (Chapman, 1997a). Not surprisingly, the answers pilots gave during the FY1997 survey as to why they declined the ACP (the bonus) corroborated the growing suspicions that pilots were unhappy with how much they had to do and how it was affecting their family (Figure 2.5).

Figure 2.5: Main Reason Pilots Did Not Accept Aviator Continuation Pay in 1997

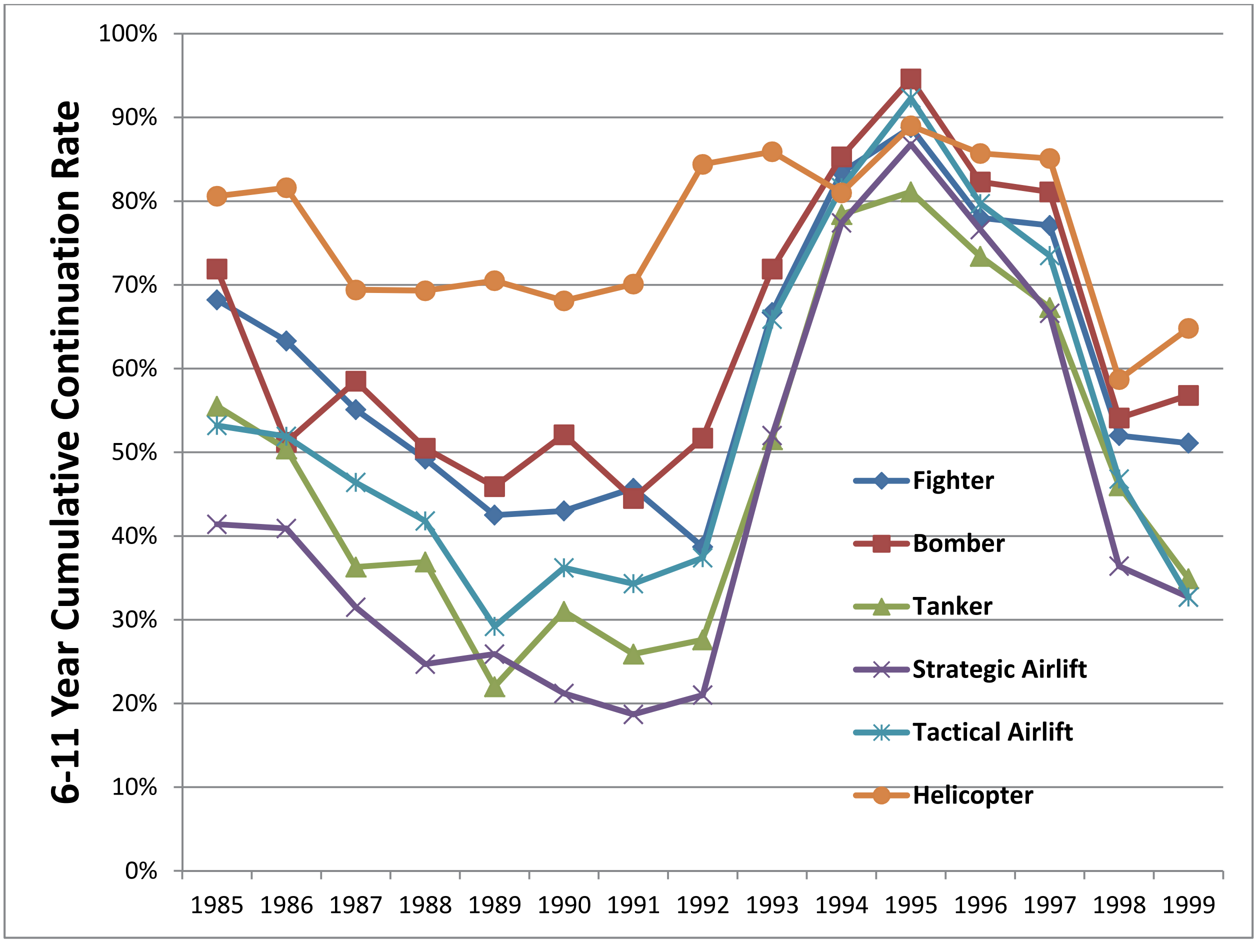


Source:(Chapman, 1997a)

In fact, the top two reasons pilots cited for declining the bonus dealt directly with the amount of time pilots were working and accounted for almost half the pilots' main reasons. If this weren't enough, the ACP and ACIP had been eroded in real value by 35 percent since 1990 (Chapman, 1997a). This drastic devaluing of pilot retention incentives no doubt did nothing to help pilots in deciding to stay longer in a career in which they felt overworked, to the point where they had concerns over their and their families' quality of life. By December of 1997, the head of the Air Force Personnel Center (AFPC), Maj. Gen. Susan L. Pamerleau, stated that pilot retention was currently the number one personnel problem (Chapman, 1997b).

Clearly, the stages were set for what could become a continuing exodus of pilots the likes of which had not been seen since the post-Vietnam era, if even then. A 2000 RAND study boiled down the tumultuously sinking total active duty pilot retention rates, captured in Figure 2.6 and broken apart by airframe, to two primary reasons. The study cited first the high operations tempo—including deployments, frequent moves, and quality-of-life issues—and second the hiring boom of the late 1990s among the major airlines (Bill Taylor; Craig S. Moore; Charles Robert Roll, 2000). These findings reinforced the results of the Aviator Survey that the DoD had conducted in 1988: that it was really pilots' experiences creating the pressure for pilots to leave. The opportunity to fly in the airlines was the escape valve. Projections that month done by the Air Force predicted a requirement for 10,000 new airline pilots per year for the next ten years, creating an escape valve large enough to outpace not just all pilot production and pilots eligible to leave the active duty Air Force, but all pilot production and pilots eligible in the Reserve and Guard components as well (Tirpak, 1997).

Figure 2.6: 6–11 Year Active Duty Air Force Pilot Cumulative Continuation Rates, by Aircraft Community, 1985–1999



Source: (Barrows, 2002), CCR 6–11 year rates.

Dot-Com Era (1998–September 2001)

As the calendar flipped to 1998, the Air Force clearly faced a challenge retaining its pilots. At the beginning of the year, the Air Force predicted a pilot shortage of 1,800 by 2002 (Grier, 1998). The number of pilot resignations jumped from 498 in FY1996 to 1,052 in the first ten months of FY1998, prompting a new, even more dire pilot shortage prediction at the end of the year of 2,300 by 2002 (United States General Accounting Office, 1999a; Grier, 1998). This prediction was bolstered by a free-falling ACP take rate, which ended the year at 26 percent. In a September 1998 speech to the Air Force Association Convention, USAF Chief of Staff Gen Ryan stated that his major concern was now the retention of our aircrews, particularly the pilot force:

> The 14 major airlines' demand is more than double the fixed-wing pilots available from all the services who have completed their service obligations. Last year we doubled the bonus we pay our pilots to remain with us for five years

> beyond their initial pilot training commitment, and while that program paid for itself in increased retention, it did not solve our pilot shortage, Our goal is for least half our pilots to stay with us beyond the nine-year point. Currently, only a quarter are electing to remain. (Major Charles E. Metrolis Jr., 2003)

As if to highlight a major source of military attrition, then Secretary of Defense William S. Cohen stated a few days later that “[w]e are deploying to more places than 10 years ago, and we are doing that with a military that is 36 percent smaller than at the end of the Cold War” ("Cohen's Vision for Strong Defense," 1998). Obviously, pilots still had to contend with high operations tempo, frequent deployments, and the consequences of those things on their families’ quality of life.

The quadrupling of deployments since the 1980s and the decreasing number of pilots left to do the job affected more than just the deployed pilots. Just over the course of 1997, Air Force personnel experienced an increase in the average number of hours they worked per week, from 47 to 50 hours (Grier, 1998). The situation was summed up by Gen. Richard E. Hawley, the head of Air Combat Command: “[Pilots] see a shortage of parts, a shortage of trained people, and an abundance of work to do” (Grier, 1998). Not surprisingly, married pilots were leaving the Air Force disproportionately more than single pilots, indicating the strain that married pilots felt staying in the Air Force. Lastly, in 1986 Congress reduced military retirement pay from 50 percent to 40 percent of average basic pay from the service member’s last three years of pay (Grier, 1998). Pilots who had witnessed this change just as they were getting into the service were now coming up to the point where they were eligible to leave active duty, and a lessened value on their military pension translated to a lessened incentive to stay for a full career.

In assessing rated management during the late 1990s, Major William J. Dalonzo captured in essence the decision environment facing pilots:

> When faced with the decision between flying jets in the military and taking care of their families, it’s not surprising that many Air Force pilots are choosing the [latter]. Facing a decline in military culture and ethos, aviators can no longer justify the hardship of deployments and lack of compensation for their families. Air Force officials are making great strides in addressing the role these factors play in retention, but the fact that the Air Force allowed quality-of-life to deteriorate in the first place is very disturbing. A work/life strategy is only successful when it is embedded in the very culture of an organization. Until recently, the Air Force failed to remember the critical role that work/life initiatives play in the success of an organization’s recruitment and retention strategy. (William J. Dalonzo, 1999)

As has already been stated, these irritants pushing pilots away from a career in the Air Force would not have been as troublesome to pilot retention if it were not for the strong U.S. job market, particularly civilian airline hiring (Grier, 1998).

Although plans to turn around pilot retention that had begun in 1997 had yet to have a noticeable impact, the Air Force continued with its plan to retain pilots by concentrating on four areas: reducing operations tempo, improving care for deployed airmen’s families, improving

quality of life, and improving personnel programs (Grier, 1998). General Ryan had recently ordered a 5 percent reduction in Air Force and joint training exercises for the next three years and a 10 percent reduction in the length and number of inspectors used for operational readiness inspections for 1998 (Grier, 1998). The Air Force looked at an ombudsman program to provide better communication and help to deployed airmen's families (Grier, 1998). The 3.6 percent boost in 1998's defense budget aided the Air Force in addressing some quality-of-life issues, such as updating 3,800 family housing units, 21 dormitories, and building three child development centers, two education centers, one family support center, and one fitness center (Grier, 1998).

The Air Force also began utilizing "rotations" of units into and out of deployments in an attempt to spread around the number of deployments (William J. Dalonzo, 1999). This strategy had been a staple of the C-130 community during the Cold War, and the hope was that the new Expeditionary Air Force would reduce operations tempo for those units hardest hit with frequent deployments, and could even "lend a semblance of predictability and stability to the lives of airmen and their families" (William J. Dalonzo, 1999).

Even with the attempts to address pilot concerns, pilot attrition was even worse in 1999 and 2000, as pilots continued to escape into high-paying airline jobs, and it became abundantly clear that the Air Force was experiencing the worst pilot shortage since at least the Vietnam War (Martin, 1999; William J. Dalonzo, 1999). The booming economy aided airline hires while increasing a six-year pay gap of about 13.5 percent between private-sector and military jobs, as pay and benefit compensation packages had stayed at or below inflation since 1993 (Martin, 1999).

In 1999, the U.S. Government Accountability Office (at that time, the U.S. General Accounting Office) gave testimony on current issues within the military pilot community and surveys it had used to determine why pilots were continuing to leave active duty service. Not surprisingly, the aviators listed better financial opportunities, improved family life, and frustrations with leadership as their three primary reasons (United States General Accounting Office, 1999b). Air Force pilots stated that "a relaxation of their deployment schedules followed closely by better pay and more choice in assignments" would encourage them to stay in the military (United States General Accounting Office, 1999b). Additionally, these pilots "grew up" in an environment where they witnessed "separation incentives, 15-year retirements, and forced early retirements after 20 years of service" (United States General Accounting Office, 1999b). They no longer viewed a military career as a guaranteed job (Dale W. Stanley III, 2012). Air Force pilots complained about having to fill junior flying positions and missing out on opportunities for traditional leadership positions, and they attributed this to personnel assignment and promotions systems that were not in sync (United States General Accounting Office, 1999b). The Air Force viewed flying as its primary mission and was keeping cockpits at 100 percent while "deliberately understaffing management positions" (Hebert, 2001). Hence, aviators saw a system where they were being reassigned to cockpit positions, and then were no longer

competitive for promotion since they had missed out on staff, leadership, and education experiences (United States General Accounting Office, 1999b).

By 2001, it was clear that pilot retention issues were “resistant to easy fixes” (Hebert, 2001). Unfortunately, the resulting pilot shortage was concentrated in the Air Force’s most valuable and difficult to replace group of pilots—those with experience (Hebert, 2001). While the recent pay, benefit, and retirement reforms addressed some financial concerns, and the Expeditionary Air Force lent a degree of predictability to pilots’ lives, experienced pilots were still being enticed out of the Air Force and into airline jobs by the thousands (Hebert, 2001).

Yet the airlines required even more pilots, and the breakneck pace of airline hiring was set to continue into the foreseeable future. “Not since the 1960s have so many ‘Help Wanted’ ads run in aviation magazines” stated the February 2001 *Air Line Pilot* magazine (Hopkins, 2001). Northwest Airlines searched for pilots in *USA Today*, while blind recruiting letters taken from FAA mailing lists were being sent to any and all pilots that met airline standards (Hopkins, 2001). In fact, 2001 was on pace to being the fifth consecutive record year for airline hiring, and military pilots were at a premium (Hopkins, 2001). That premium prompted major airlines to offer salaries and retirement packages that dwarfed what the Air Force could offer (Kafer, 1998).

Halfway through the year, the Chief of Staff of the Air Force upgraded pilot retention as the most pressing problem facing the Air Force (Dale W. Stanley III, 2012). The simple pilot retention rate had been decreasing since 1995, and nothing in 2001 suggested an improvement in the Air Force’s retention of pilots. The situation the Air Force found itself in was simple: Air Force pilots had reasons to leave active duty, and the airlines had jobs with higher pay waiting for those who did.

Post-9/11 Era (September 2001–2013)

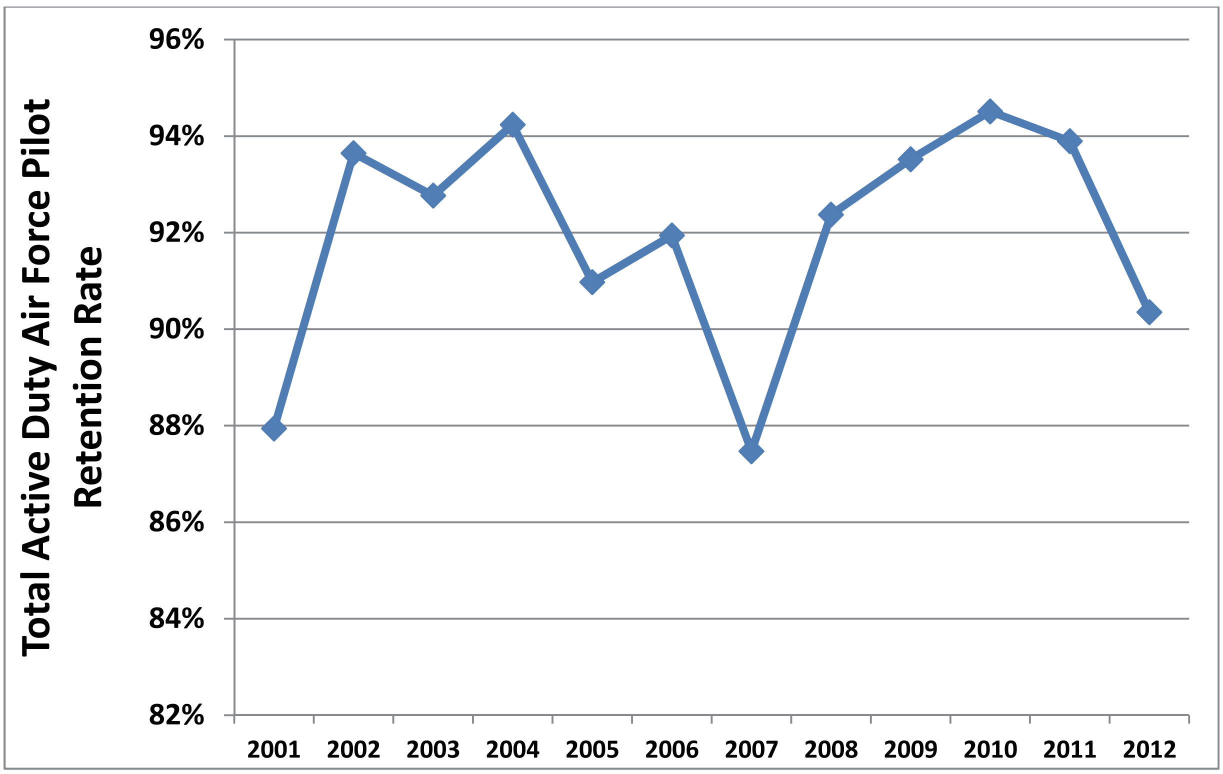
Then, in an instant, the bleak outlook on pilot retention changed. What once was a perfect storm contributing to pilot shortages and low retention rates suddenly become a perfect storm of factors that improved pilot retention and began making a significant dent in the heretofore impervious pilot shortage. After 9/11, airlines suffered a sizable drop in business and had to curb hiring and even furlough many of their experienced pilots (Newman, 2003). This contributed to an easing of the pull pilots felt to leave active duty for airline jobs for the next few years (Callander, 2006).

While the Air Force had implemented an indefinite blanket Stop-Loss on its pilots following 9/11, there were many indicators that showed pilots now valued serving above flying for the airlines (Philpott, 2002). The ACP take rate, which had been hovering at or below 30 percent for the preceding few years, bounced to nearly 50 percent for the long-term bonus in 2002 (Hebert, 2003). Despite still earning far less than they would flying in the airlines, even after considering ACP, the sudden improvement in pilot retention and ACP take rate was being attributed by USAF’s Director of Operations and Training, Major General Richard A. Mentemeyer, to the global war on terror: “Even though people are gone from home a lot more…they feel very good about what they are doing, and so do their families” (Hebert, 2003). Hundreds of pilots who had

left the service prior to 9/11 were also voluntarily returning to help fill vacancies (Hebert, 2003). Even after Stop-Loss was repealed, no exodus of pilots ever materialized, and the Air Force retained more pilots than expected (Hebert 2003).

Thus, just a few years after the Air Force's worst pilot retention era since at least the Vietnam War, the pilot retention situation had reversed (Figure 2.7). "[R]enewed patriotism and sense of purpose" justified the previously untenable high operations tempo and frequent deployments for the pilots and their families (Callander, 2006). Just as the pilot retention environment in the years 1998 to 2001 reflected a continuation of 1997, the years 2003 to 2006 reflected the positive retention environment that developed as a result of 9/11 and the nation's response.

Figure 2.7: Annual Active Duty Air Force Pilot Retention Rates, 2001–2012



Source: (RAND Corporation, 2013)

Although there was concern that when Stop-Loss was lifted there would be a rush to the door and retention rates would once again dip, that scenario never materialized (Callander, 2006). Even in the face of high operations tempo, the Air Force had enacted a number of measures aimed at keeping pilots in active duty. In 2000, the Air Force had upped ACP to $25,000 per year for committing to an additional five years of service, and after 9/11 it was still offering pilots this deal (Major Charles E. Metrolis Jr., 2003). Pilots that met their flying "gates" were also eligible to receive ACIP—now increased to $840 per month for pilots with between 14 and 22 years of aviation service (Barrows, 2002). Pilots also enjoyed more predictable deployments,

and patriotism remained a factor (Callander, 2006). Thus there was still decidedly less pressure on pilots to leave active duty than there had been before 9/11. Moreover, even the pilots that wanted to leave encountered low airline hires. Major airlines hired as many pilots in the four years from 2002 to 2005 as they had in 2001 alone (FAPA.aero). In an environment where fewer pilots were dissatisfied with the Air Force and fewer pilots were being hired by the airlines, it is not surprising that pilot retention rates stayed well above 90 percent from 2002 to 2006.

No matter what level of wartime or peacetime operations, the mid–2000s were set up to have higher than normal total pilot retention anyway. The Air Force had severely cut accessions in the mid-1990s, before foreseeing a looming pilot shortage and revamping accessions back to normal levels. This created a particularly low number of pilots who had expiring ADSCs during the years 2003–2006 (Callander, 2006). As this trough of pilots reached the end of their ADSC, there was obviously a disproportionately low number of pilots eligible to leave compared with years past. Therefore, it is to be expected that these years had relatively high pilot retention rates.

What may appear unexpected, though, is the 2007 dip in retention. This dip can largely be attributed to a number of force shaping initiatives offered in 2006 that affected 2007's rates (Dale W. Stanley III, 2012). In this fiscal year, the Air Force lost 559 pilots to force-shaping measures such as the voluntary Limited Active Duty Service Commitment program (129 pilots, including PALACE CHASE pilots), the Voluntary Separation Program (379 pilots accepting bonuses for separating early), and the 51 pilots leaving involuntarily via the Selective Early Retirement Board (Air Force Personnel Center, FY 07). These measures were intended to lend a degree of predictability to future retention rates while keeping the pilot field above sustainment levels, and also to curb what could have been a future exodus of pilots into the airlines (Air Force Personnel Center, FY 07). By allowing this crop of pilots to leave on the Air Force's terms, the service felt positive about the coming years' retention rates and could develop personnel plans based off relatively more predictable retention rates (Air Force Personnel Center, FY 07).

As expected, 2008 to 2010 had very high retention rates, with 2010 experiencing the highest retention rate since the Vietnam War. 2010 broke 2008's record ACP take rate of 68 percent, with a staggering 76 percent of eligible signing on for additional years (though 2010 had a very small pool of only had 34 eligible pilots) (Air Force Personnel Center, FY 10). Starting in 2008, a smaller pool of eligible pilots was expected, due to a change in ADSC policy going into effect between 1999 and 2001 that moved the commitment length from eight to ten years. This significantly decreased the number of pilots eligible to leave active duty for the next two years. Nonetheless, 2008–2011 had strong showings in terms of retention rates and ACP take rates, setting up a positive next few years of retention with a large stock of pilots agreeing to additional service and thus "almost guaranteeing a pilot stays until 20 years of service" after taking on the additional ACP commitment (Air Force Personnel Center, FY 07).

Something else may have contributed to the high retention and take rates of 2008 to 2011: the economy. When the bottom fell out on the U.S. economy in 2008, the airlines registered the

impact immediately. After increasing hiring numbers the previous few years, major airlines' hiring in 2008 was less than half what it had been in 2007, and airline hiring in 2009 plummeted to nearly zero, with only 30 total major airline hires the whole year (FAPA.aero). The two years from 2010 to 2012 also had low numbers of airline hires, with those years totaling up to still a 1,000 less than had been hired in 2007 (FAPA.aero).

Nevertheless, the wars had been quietly taking their toll on pilots, and by 2009 and 2010 the pressure was noticeably mounting on active duty pilots. The infamous "Dear Boss" letter resurfaced in 2009, rewritten to capture the building pressure pilots were beginning to feel. The author penned how they were waiting for a door to open (waiting for eligibility) so they could escape the "long hours with little support, no stability or predictability to life, zero career progression, and senior commanders evidently totally missing the point" ("Dear Boss 2009," 2009). Surveys conducted in the summer of 2010 revealed that morale among service members was on the decline and could largely be attributed to multiple deployments to warzones and the consequential stress and anxiety on service members and their families (Mulrine, 2011). But since major deployments to the Middle East were being planned to phase out, the main factors contributing to reduced morale were expected to improve (Andrew Feickert; Stephen Daggett, 2012).

In 2011, other early warning signs suggesting future troubles retaining pilots came to light. In an attempt to reach congressionally mandated end-strength, the USAF offered a Voluntary Separation Pay (VSP) program to specific year groups and specialties (Dale W. Stanley III, 2012). Out of the 915 program applicants, more than 400 were pilots (Dale W. Stanley III, 2012). Just 8 percent of the 400 pilots were approved, in contrast to all other career fields, which had a combined approval rate of almost 47 percent (HAF/A1PP, 2011). Mobility pilots accounted for nearly half of the pilots applying for VSP, at a time when the mobility career field was having to fill in Combat Air Force nonflying billets due to the ongoing fighter pilot shortage (Dale W. Stanley III, 2012).

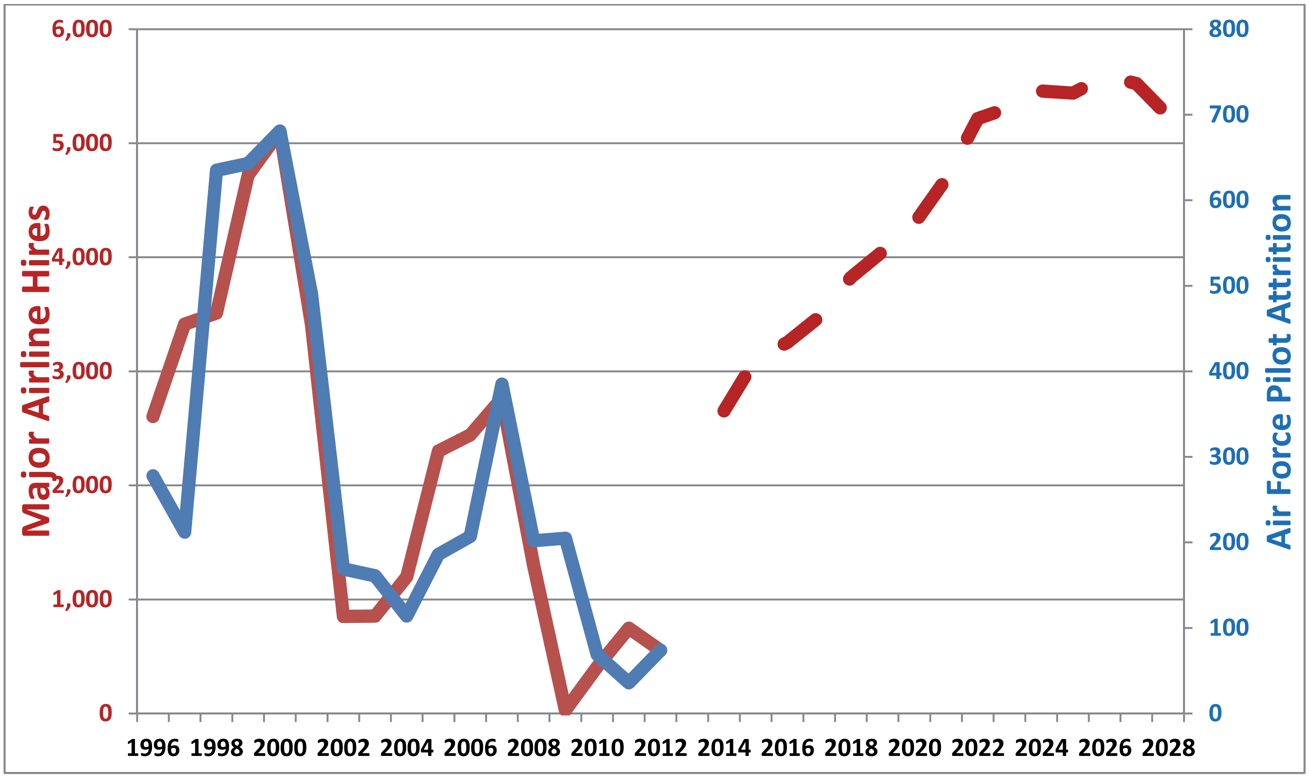
After military budgets had grown annually since 2001, the Budget Control Act of 2011 reversed this trend. The Air Force now faced the next decade constrained by a smaller budget and had to balance the reduced funding against retention while avoiding slipping into another "hollow force" era (Andrew Feickert; Stephen Daggett, 2012).

The Airline Recovery Era (2013 and Beyond)

The Air Force now finds itself in the precarious position of having a very experienced stock of mid-level pilots approaching the end of the initial ADSCs. At the same time, the major airlines are estimated to increase and maintain their hiring above levels not seen since the last great pilot exodus in the late 1990s. Thus, this next era could be defined more by the number of major airline hires and less by the Air Force trying to draw down its pilot corps. Whereas in other years of relatively low major airline hires the Air Force simply managed its pilot attrition to balance its inventory and requirements, it now has another somewhat uncertain factor to contend with. The

impact of that factor—major airline hiring—could have a profound effect both on the numbers of active duty pilots exiting the service and the shape of the Air Force in the years to come.

Figure 2.8: Major Airline Pilot Hiring Versus Air Force Pilot Attrition, with Future Estimated Major Airline Pilot Hiring (shown by the dashed red line)



Source: (Future & Active Pilot Advisors, 2013a; RAND Corporation, 2013)

Internal Influences

To bring this chapter into perspective, the intent has been to identify the changes in pilot attrition throughout the years and begin to draw connections to various external and internal factors influencing pilots in making their decision. Major airline hiring remains one such external factor that cannot be ignored. The remainder of the chapter further discusses some internal factors that also need to be fleshed out further before the next chapter can begin to attempt modeling the pilots' decisions.

The Air Force has a number of levers it can maneuver to influence pilot attrition. Most apparently, it can change the length of time that pilots must serve in order to be eligible to leave active duty. Increasing the commitment length has not only guaranteed additional numbers of years pilots are required to serve, it can also change a pilot's decision. Lengthening the commitment places pilots closer to retirement eligibility. It is likely that longer commitments

bring about an increased number of pilots who are no longer willing to leave active duty until they are at least eligible for retirement.

There are also monetary incentives—in addition to base pay—offered to pilots that may influence pilot attrition. ACIP, also known as "flight pay," is offered to pilots throughout their career. ACP, also known as the "bonus," is given to pilots who take on an additional commitment term, and it can be paid out in annual sums or larger lump sums.

The retirement pension and benefits can also be viewed as an attrition mechanism. The Air Force has experimented with a number of different retirement policies that change how retirement pay is both calculated and paid. Lastly, a number of different experiences that a pilot and hos or her family have throughout the career can impact a pilot's decision.

Active Duty Service Commitment

Upon completion of pilot training, an active duty pilot incurs an obligation to serve in the active duty corps for a specified number of years. ADSCs have been revised throughout the years for different career fields depending on personnel needs (USAF, 25 November 2009). All has been in the name of force management. The length of an ADSC is important for a few reasons. For one, it guarantees a specified number of years that a pilot owes the Air Force as a return on the Air Force's investment in training the pilot. It also ensures that a healthy stock of mid-career pilots will be available with enough experience to turn around and help train the new pilots being absorbed into the active force. Additionally, the obligation may push some pilots close enough to retirement that they are past their threshold of leaving the Air Force before retirement for a new career. This helps keep experienced aviators in the force and available for leadership and staff positions.

Currently, a newly minted pilot incurs a ten-year ADSC. Throughout the 1960s, 1970s, and most of the 1980s, pilots had six-year ADSCs (Bruce A. Guzowski, 1990). Due to persistent costs, a forecasted pilot shortage, and the need to boost the proportion of pilots with 6–12 years of aviation service, the Air Force raised the ADSC to seven years in 1987 (Major Charles E. Metrolis Jr., 2003). Between September 1987 and the release of the Presidential Budget for FY1988, the projected pilot shortage grew to 2,000 pilots by the end of FY1992, prompting the Air Force to increase the ADSC from seven to eight years in 1988 (Stanley, 2012).

An eight-year ADSC remained the norm for the rest of the next decade until increasing costs, the start of another pilot shortage, and stubbornly low retention rates prompted the Air Force to increase its initial service obligation for pilots to ten years (Major Charles E. Metrolis Jr., 2003). The Air Force Chief of Staff justified the increase, stating that he did not believe the retention problem could be fixed by throwing money at the situation, and he wanted to give the Air Force a better return on its investment in training the pilots (William J. Dalonzo, 1999). The new commitment went into effect in 2000, but U.S. Air Force Academy (USAFA) upperclassmen were "grandfathered" in at eight years (Hebert, 2003). This meant the policy would not start affecting the pilot population until around 2009, and even then the full effect of the policy would

not be felt until after 2011 (Hebert, 2003). Increasing the ADSC to ten years helped address the issue of having enough pilots with 6–12 years of aviation service, but it is an exhaustible strategy since “Air Force officials are reluctant to increase the commitment because of its potential to negatively [affect] recruitment” (Major Charles E. Metrolis Jr., 2003). However, with the recent change in minimum flying hours for the airline industry, an ADSC increase might no longer negatively impact recruitment, due to the increased barriers in becoming a major airline pilot from the civilian side.

Table 2.3: ADSC Lengths by Fiscal Year

Fiscal Year	ADSC
Pre-1987	6
1987	7
1988–1999	8
2000–present	10

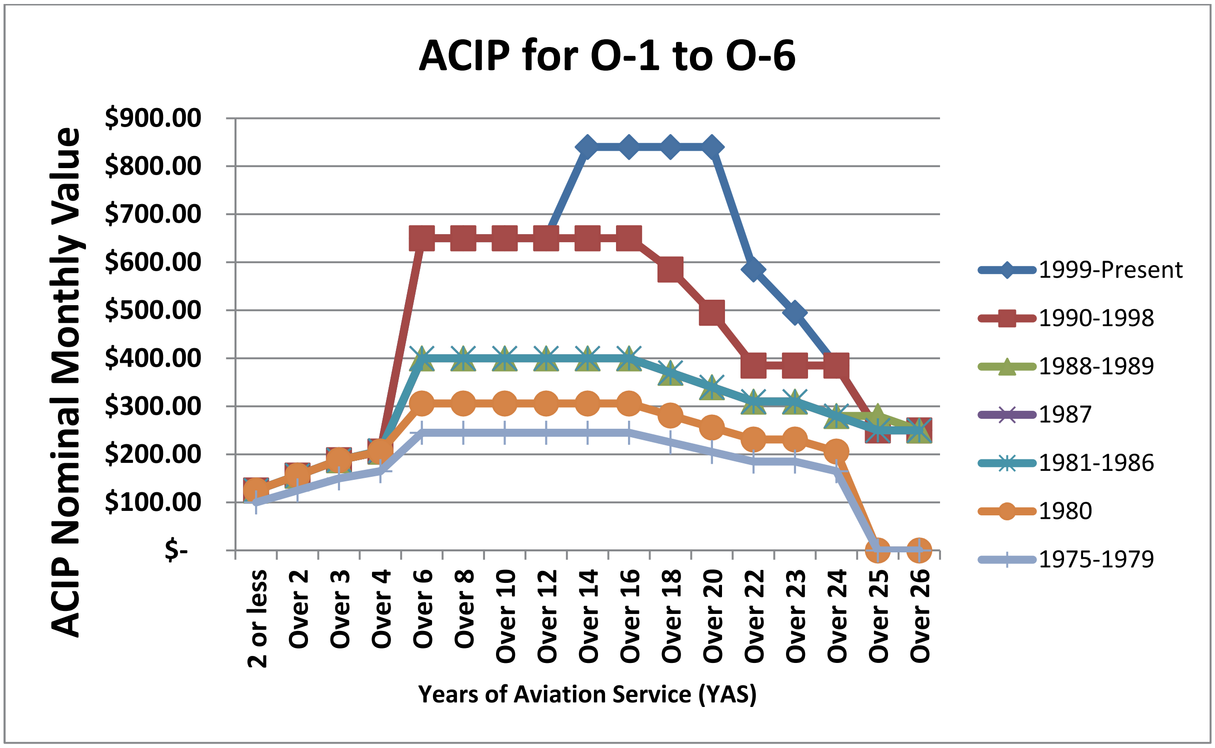
Aviation Career Incentive Pay

Active duty pilots, including pilots in training, receive ACIP, a monthly flight pay. This flight pay has its roots in the Army Appropriation Act of 1913 that increased pay and allowances by 35 percent for “heavier-than-air craft pilots” (Bartholomew, 1982). Keeping with the traditional monthly monetary incentive to attract and keep pilots in the Air Force, the ACIP Act of 1974 was passed to legally structure the monthly flight pay (William J. Dalonzo, 1999). Pilots receive ACIP as long as they meet certain timing requirements, referred to as “gates” (O'Brien, 2000). In order to receive ACIP through an aviator’s 25th year of aviation service (YAS), a pilot must fly at least eight of their first 12 YAS and 12 of their first 18 YAS (O'Brien, 2000). If the pilot flies between ten and 12 of their first 18 YAS, he or she is entitled to ACIP only through 22 YAS (O'Brien, 2000).[3] If a pilot does not meet these gates and is currently not flying, he or she does not receive ACIP.

Even though ACIP had its roots as an incentive to service members taking on additional hazards, it has come to be used as a long-range retention mechanism (Major Charles E. Metrolis Jr., 2003). As Figure 2.9 shows, ACIP clearly resembles a “bell-shaped” curve, targeting experienced pilots with over six YAS. The pay currently increases even more once a pilot achieves 14 or more YAS, as the Air Force attempts to incentivize experienced senior pilots into staying on for leadership, command, and staff positions (Major Charles E. Metrolis Jr., 2003). ACIP has been revised six times since the end of the Vietnam War, and, strikingly, the five latest revisions have changed ACIP for YAS of six or more but not for YAS less than six years. This may hint at retention efforts focusing on pilots nearing, or at, the end of their initial ADSC.

[3] YAS is different from YOS. Years of service (YOS) measures how many years the individual has been in the Air Force, while years of aviation service (YAS) measures how many years the individual has been flying in the Air Force.

Figure 2.9: ACIP Nominal Monthly Values, 1975–2014



Source: (Defense Finance and Accounting Service, 2012)

The most recent revision, completed in 1999, changed the shape of the ACIP curve by increasing the amount pilots receive after 14 YAS (Table 2.4). After receiving the most significant increase upon hitting six YAS, the additional increase at 14 YAS provides both an incentive for pilots with less than 14 YAS to stay longer to reach the higher ACIP and an incentive for pilots nearing retirement to stay and continue to receive the highest value of ACIP.

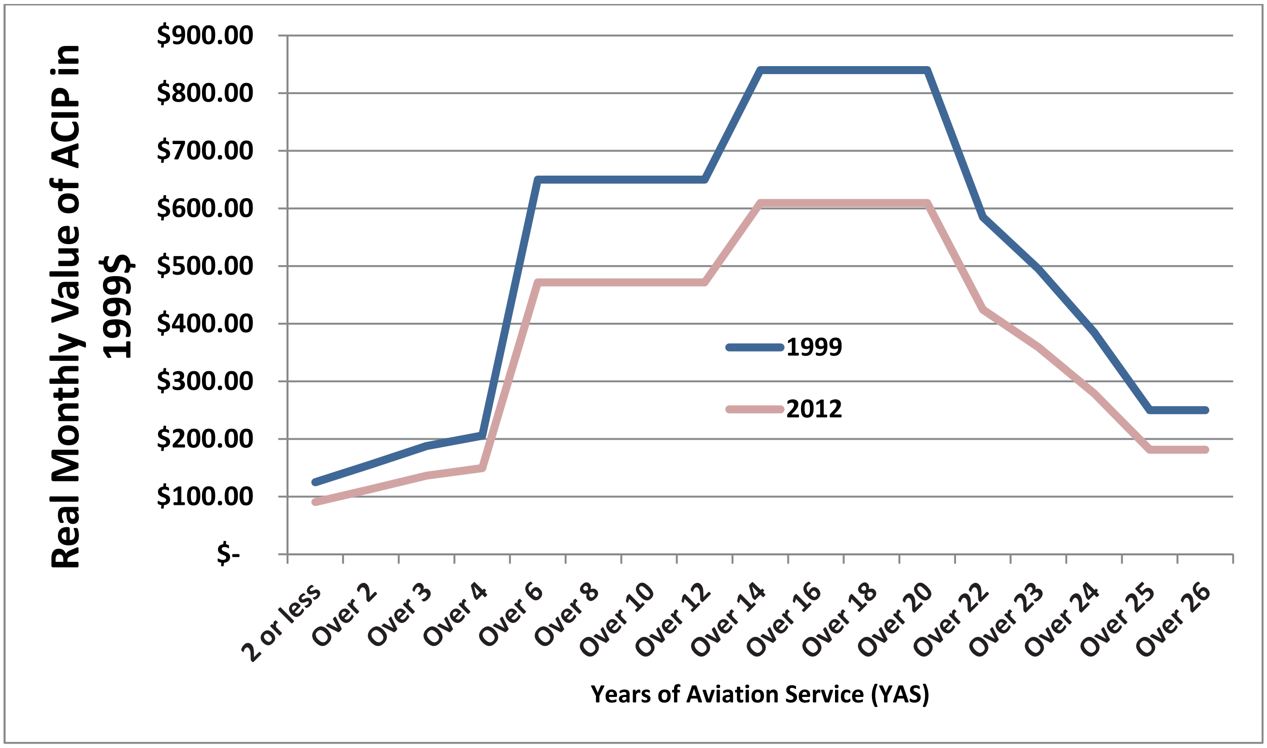
Table 2.4: Current ACIP Nominal Monthly Values by YAS

	YAS (Including Flight Training) as an Officer									
	2 or less	Over 2	Over 3	Over 4	Over 6	Over 14	Over 22	Over 23	Over 24	Over 25
Monthly pay	$125	$156	$188	$206	$650	$840	$585	$495	$395	$250

Source: (Department of Defense, 2011)
Notes: O-7 and O-8 pilots with greater than 25 YAS may not receive ACIPs greater than $200 and $206 a month, respectively (Department of Defense, 2011).

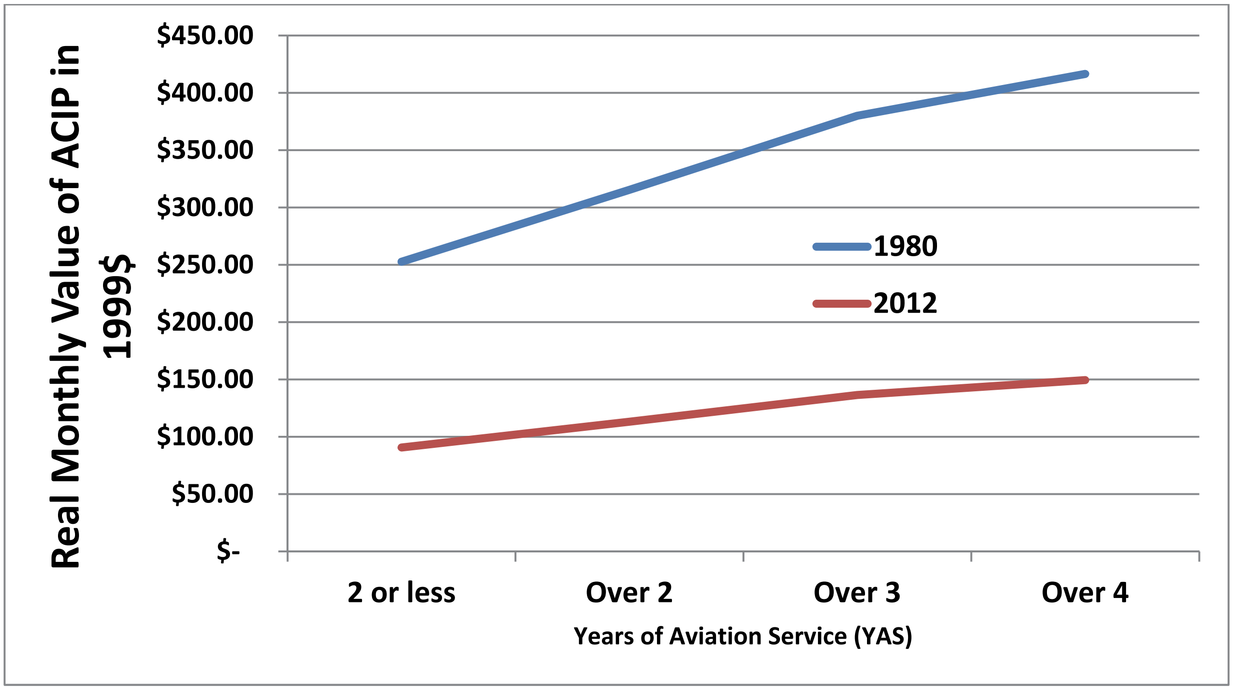
However, as of 2012, the real value of the ACIP had declined to 73 percent of its value since the 1999 adopted value (Figure 2.10). Moreover, the ACIP in 2012 for the first six YAS was the same nominal value as the one implemented in 1980, meaning it had decreased to 36 percent of its adopted value.

Figure 2.10: ACIP Real Monthly Values, 1999 Versus 2012



The erosion in real value since 1980 is most pronounced for pilots with less than six YAS (Figure 2.11). The real value of the ACIP in 2012 is 2.5 times less than the real value from 1980. A pilot with five YAS in 2012 was making less in real terms than a student pilot with less than one YAS in 1980. It is obvious that in fixing the nominal value of the ACIP, inflation has a profound effect on the real value of the ACIP if it goes unadjusted for many years. In the 20 years from 1979 to 1999, the ACIP was updated six times, to help account for inflation. In the 15 years since 1999, it has not been updated once. If pilot attrition does indeed start to rise in the future, it may be time to revisit the ACIP's real value as a potential avenue for affecting pilot attrition.

Figure 2.11: ACIP Real Monthly Values for YAS < 6, 1980 Versus 2012



Aviation Continuation Pay

The second of the two monetary incentives for pilots is the ACP. This bonus has been as low as $6,000 for an extra year of commitment, to its current high of $25,000 annually for pilots agreeing to stay an extra five years beyond their initial ADSC. In general, the longer the contractual commitment, the larger the bonus (Barrows, 2002).

The ACP has its roots in the Aviation Officer Continuation Pay (AOCP), which was authorized by Congress in 1981 to pay an annual bonus of $6,000 to each pilot with 6–12 YOS (William J. Dalonzo, 1999). Initially, only the Department of the Navy participated (William J. Dalonzo, 1999). In 1988, 39 percent of surveyed pilots labeled pay bonuses for serving additional years as the most effective option for improving retention (*DoD Aviator Retention Study*, November 1988). Consequently, after military pilot losses continued to increase past predictions, Congress signed ACP legislation going into effect in 1989 that provided $12,000 annual bonuses for Air Force and Navy pilots agreeing to stay until 14 YOS after fulfilling their initial ADSC (William J. Dalonzo, 1999; Bruce A. Guzowski, 1990; *Military Compensation Background Papers: Compensation elements and related manpower cost items*, 1996).

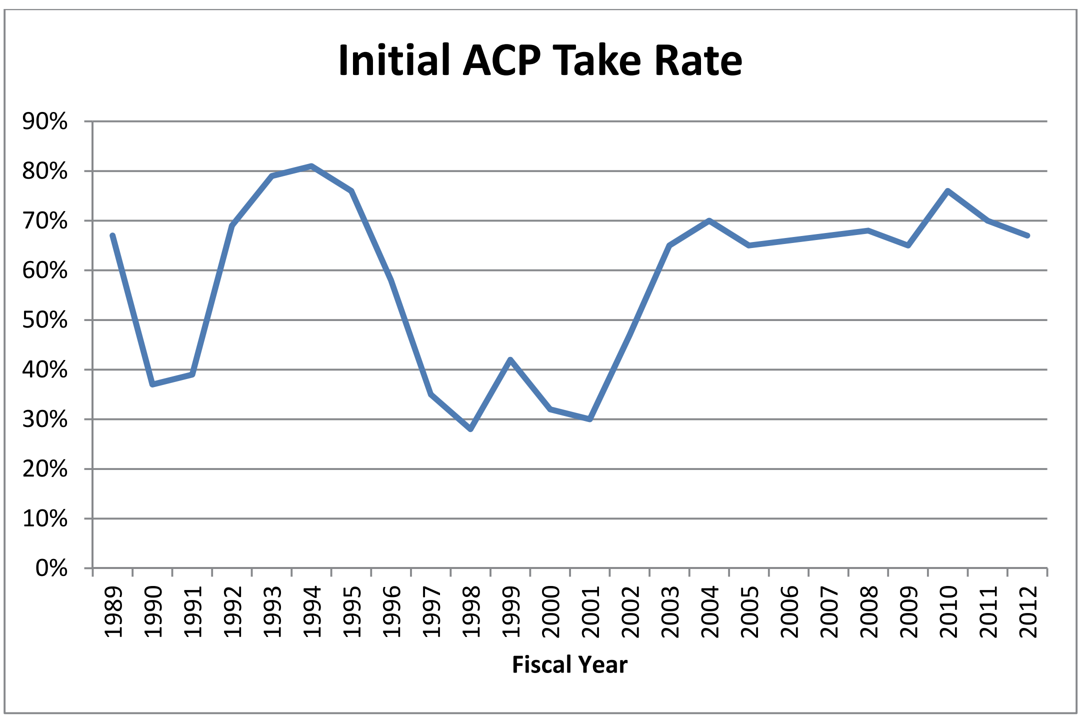
The new bonus was met with less enthusiastic results than expected: while 66 percent of eligible pilots accepted the ACP in FY89, the majority of those pilots had already served more than ten years of aviation service (Hock, 1999). By the end of the calendar year, the yearly take rate had dropped to a dismal 36 percent (Hock, 1999). The Air Force decided to revise the ACP in 1991 by offering two versions: the original version, and a new option that allowed pilots to

take half the total ACP amount as an up-front lump-sum (Ortiz, 2003). In 1996, the ACP was expanded in the Air Force beyond fixed-wing pilots to rotary-wing pilots as well (Ortiz, 2003).

Interestingly enough, even though the Air Force had a pilot surplus, and major airline hiring had tapered off in the first half of the 1990s, the Air Force did not change the ACP program during this time, even though it was slashing pilot production and waiving pilot ADSCs (William J. Dalonzo, 1999). What's more, pilots who did not accept the ACP were often grounded and made available for short-notice nonflying assignments (Hock, 1999). Needless to say, some were beginning to question the need for a bonus program paying large sums of money during a drawdown era when airlines were no longer poaching pilots as they had been just a few years prior (William J. Dalonzo, 1999).

That era was short-lived, and after increasing the first few years after the ACP inception, the take rate had begun to decline in 1995. This became the prelude to the large late 1990s pilot exodus. The increasing airline hiring and decreasing take rate and retention rate influenced the enactment of the FY1998 National Security Defense Authorization Act, which increased the ACP to a maximum value of $22,000 per year through 14 YOS, applying retroactively to 1997 agreements as well, while also offering shorter-term options of one-, two-, or three-year agreements at $6,000, $9,000, or $12,000 per year, respectively (Major Charles E. Metrolis Jr., 2003; Ortiz, 2003).

Figure 2.12: Initial Annual Aviator Continuation Pay Take Rate, 1989–2012



Source: (Air Force Personnel Center, FY2012)

Nevertheless, after the FY1998 take rate declined to 26 percent, the Air Force decided to up the ante, using the FY2000 National Security Defense Authorization Act as authority (Grier, 1998; Major Charles E. Metrolis Jr., 2003). The Air Force was able to offer three-year or less agreements at $15,000 per year and five-year deals at $25,000 per year, and these offers were valid for pilots, including colonels, until 20 and 25 YAS (Major Charles E. Metrolis Jr., 2003). Pilots under previous agreements could amend theirs to match the new contracts, and the up-front lump-sum offer was still being offered as an option as well, with a cap at a $100,000 up-front lump-sum (Ortiz, 2003; Major Charles E. Metrolis Jr., 2003). After the revamped ACP program, more than 8,000 pilots were eligible for either a renegotiated or initial bonus in FY2000—a significant increase over what is normally less than 1,000 eligible pilots per year (Ortiz, 2003). The FY2001 and FY2002 ACP programs kept the same structure, except the lump-sum maximum payment was raised to $150,000 in anticipation of an increased future incentive for pilots to stay longer, into their 20 and 25 YAS (Ortiz, 2003).

There were no additional bonus options the rest of the decade, as the Air Force enjoyed high retention and ACP acceptance rates (Air Force Personnel Center, 2013). The most significant change to the ACP during these years occurred in 2005, when the options extending the ACP into 20 and 25 YAS were canceled, leaving the five-year option as the longest-term agreement available to pilots (Dale W. Stanley III, 2012; Air Force Personnel Center, 2013). During these years, the take rate revealed a comfortable level of retention, since even though the Air Force "unofficially states that it would like to retain 100 percent of its pilots…the 63-percent figure still holds as the official goal," and the take rates from 2003–2012 signaled retention rates above the 63 percent target (Major Charles E. Metrolis Jr., 2003; Air Force Personnel Center, 2013). (Figures for ACP update are given in Tables 2.5, 2.6, and 2.7.)

Even though the ACP is used as a tool to manage pilot retention numbers, it has faced scrutiny from both within and outside the Air Force. In 2008, Major Brian Maue argued in *Air & Space Power Journal* that using ACP as a "buffer" against airline hires was a flawed practice, since the pay gap between the two competing industries had decreased to the point where the additional bonus did not generate higher retention rates (Major Brian Maue, 2008). The common justification for ACP was that the $125,000 bonus was worth it if it retained pilots who received training worth millions (Dale W. Stanley III, 2012). Major Maue countered this argument by stating that it had not been proven that pilots accepting the bonus would have left the Air Force in the absence of an ACP program (Major Brian Maue, 2008). His claims had been made before, beginning early in the program's history, after its first few years were still met with lower-than-expected retention rates (William J. Dalonzo, 1999).

While the introduction of the ACP may not have produced the desired reduction in pilot attrition, the bonus is not viewed as a failure. Those who accept the bonus incur a service commitment, and so Air Force personnel planners know which pilots will not be able to leave the military in future years (John Ausink; David A. Wise, 1996).

However, it must be noted that previous studies from outside the military failed to find a significant correlation between monetary incentives and retention rates as well (Pulley, 1998). Additionally, officer surveys continued to highlight other issues—such as quality of life, operations tempo, assignments, additional duties, promotions, and ACIP—as perhaps having more influence than the ACP on a pilot's decision to stay or leave the Air Force (Major Charles E. Metrolis Jr., 2003). Thus, it may be possible that although the ACP does not significantly alter retention rates, it does serve in adding a degree of certainty to the personnel planning process and consistency and knowledge in the Air Force's ranks.

Table 2.5: Number of Active Duty Pilots Accepting Additional ACP Commitment Following Initial ADSC[4]

FY	Initial Eligibles	3-Year Policy at $15K/Year	5-Year Policy at $25K/Year	20 YAS	25 YAS	Total
2000	783	56	81 [1]	152	19	308
2001	795	56	99 [2]	116	22	293
2002	521	58	91 [2]	134	19	302
2003	450	26	132 [2]	153	9	320
2004	497	X	146 [3]	200	X	346
2005	645	X	420 [3]	X	X	420
2006	765	X	507	X	X	507
2007	853	X	571	X	X	571
2008	973	X	594	X	X	594
2009	662	X	437	X	X	437
2010	34	X	26	X	X	26
2011	202	X	141	X	X	141
2012	827	X	550 [4]	X	X	550

[1] 50% Lump-Sum Option offered, capped at $100,000.
[2] 50% Lump-Sum Option offered, capped at $150,000.
[3] 50% Lump-Sum Option offered.
[4] 50% Lump-Sum Option offered only to 11F or 11U PAFSFY

[4] Assembled using Rated Officer Retention Analyses from FY2000-FY2012 as provided by AFPC/DSYA.

Table 2.6: Number of Non-Retirement Eligible Active Duty Pilots Accepting Additional ACP Commitment Following Non-Initial ADSC[5]

Year	Uncommitted Eligibles	3-Year at $15K/Year	4-Year at $15K/Year	5-Year at $15K/Year	Accept
2009	399	12	11	9	32
2010	185	14	9	8	31
2011	51	3	3	1	7
2012	43	4	1	0	5

Table 2.7: Number of Retirement Eligible Active Duty Pilots Accepting Additional ACP Commitment[6]

FY	Retirement Eligibles	3-Year at $15K/Year	4-Year at $15K/Year	5-Year at $15K/Year	Accept
2009	499	77	52	38	167

Retirement

Another significant component of the military compensation system that affects pilot retention is the military retirement system. There have been three different non-disability retirement systems in effect since 1947: the Final Pay Retirement System (Final Pay), the High-3 Year Average Retirement System (High-3), and the Career Status Bonus and REDUX Retirement System (CSB/REDUX or REDUX) (Asch, 1998). All three retirement systems are “cliff-vested” at 20 YOS, meaning that active duty service members do not receive a retirement pension unless they have served at least 20 years (Barrows, 2002). Which system an individual falls under depends on the date that individual first entered the military (Asch, 1998). This date is determined by the first time an individual enlisted or joined the actives or reserves (2013). For USAFA graduates, this is the first date they reported to the Academy (2013). For Reserve Officers Training Corps (ROTC) graduates, the date is set by their ROTC program (2013).

The Final Pay Retirement System applies to individuals who entered the military prior to September 8, 1980 (Department of Defense, 2013). Final Pay refers to the final monthly basic pay the individual received, and gives the individual a monthly retirement payment of 2.5 percent of each YOS toward their final pay (2.5 percent × YOS × final basic pay) (Asch, 1998).

[5] Assembled using Rated Officer Retention Analyses from FY2000-FY2012 as provided by AFPC/DSYA.

[6] Ibid.

Service members reach the maximum value of 75 percent of their final pay at 30 YOS (Department of Defense, 2013). Final Pay protects individuals' retirement pension from inflation by annually indexing Cost of Living Adjustments (COLA) on the Consumer Price Index (CPI) (Department of Defense, 2013).

An individual is eligible to receive the High-3 Year Average Retirement System if they entered the military on or after September 8, 1980, but before August 1, 1986, or they entered on or after August 1, 1986, and did not choose REDUX (Department of Defense, 2013). The monthly retirement payment, is the same except the pay is now determined by the average of the highest 36 months of basic pay (Department of Defense, 2013). This retirement system is on average lower than Final Pay, since the High-3 average is at most equal to an individual's basic pay preceding retirement, and is often lower because of basic pay raises for longevity (Barrows, 2002). High-3 also fully accounts for inflation (Asch, 1998).

The Military Retirement Reform Act of 1986 (initially referred to as just REDUX) applies to individuals entering the military on or after August 1, 1986 (Asch, 1998). The act changed the annuity formula to 40 percent of the High-3 average basic pay plus an additional 3.5 percent for each year beyond 20 YOS ([40% + 3.5% × (YOS – 20)] × High-3 average basic pay) (Asch, 1998). Under REDUX, annual COLA adjustments are equal to the CPI minus 1 percent (Department of Defense, 2013). Two adjustments are made at age 62. First, the retirement pay percentage changes to what it would have been under High-3 (2.5% × YOS × High-3) (Department of Defense, 2013). Second, full CPI is applied to every retirement year to amend the retirement salary based on the COLA adjustments (Department of Defense, 2013). However, REDUX COLAs for subsequent years are again equal to the CPI minus 1 percent (Department of Defense, 2013).

Before anyone under REDUX could hit 20 YOS, the National Defense Authorization Act for FY2000 amended REDUX to give members entering the military on or after August 1, 1986, the option at their 15th YOS of either the High-3 system or the REDUX system with an additional $30,000 Career Status Bonus (Department of Defense, 2013). To receive the bonus, the individual commits to a 20-YOS obligation (Department of Defense, 2013). The entire bonus, or the first installment payment if the individual chose a multiyear plan, is paid upon the CSB/REDUX election (Department of Defense, 2013).

There are a number of pieces of the retirement systems that may influence a pilot's attrition decision. First and foremost, "cliff-vesting" provides an incentive for pilots to stay until 20 YOS. Since pilots receive no pension unless they stay at least 20 years, it is in the pilot's best interests to make the decision of staying or leaving well before 20 years. This creates a window of opportunity for pilots to leave between the fulfillment of their ADSC and around the 15-YOS mark, the time after which pilots generally stay until at least 20 YOS.

"Cliff-vesting" may also force pilots to make important career decisions prematurely. A pilot just reaching the end of his or her ADSC at, say, 12 YOS, may feel pressure to immediately make the decision about staying or leaving. Since leaving at 12 YOS is probably preferable to

leaving at 15 YOS, this additional pressure may influence pilots to make their decision earlier and without knowing the future state of their career in the Air Force or outside of the Air Force than would otherwise occur under a system without "cliff-vesting."

The REDUX system may have altered when and how much incentive pilots have for staying in the Air Force. The change from 50 percent to 40 percent of retirement pay at 20 YOS may have diminished the incentive at completion of the initial ADSC for pilots who were interested in staying until 20–30 YOS. However, for pilots with 20–29 YOS, the REDUX system may provide additional incentive, since each additional year provides a 3.5 percent, as opposed to a 2.5 percent, increase in retirement pay over the previous year.

The retirement system essentially forces pilots to assert their levels of commitment to the Air Force or to organizations outside of the Air Force. In organizational psychology, cognitive-continuance commitment is a way of viewing the utility gained by an individual in continuing at an organization compared with the cost with leaving the organization (Allen, 1990). There is also the issue of the individual choosing a different social identity in changing jobs. Thus there may be inertia for pilots to stay in the Air Force, and the inherent lost value of a retirement pension is one potential barrier for some pilots in leaving before they are retirement-eligible.

Operations Tempo

While much of the historical review has discussed the impact of operations tempo on pilot attrition, operations tempo by itself may not be a determinant in pilot attrition one way or the other. Rather, pilots may let operations tempo influence their decision only when other factors are present or not present. For example, in a 1997 survey, operations tempo was the main factor in pilots departing the Air Force, and the second response was quality-of-life factors (William J. Dalonzo, 1999). But 2003 had a higher operations tempo, but the pilots were getting "what they came in the military to do…[and] tend[ed] to hang around" (Hebert, 2003). Revealingly, in 2006 personnel surveys revealed that "patriotism, quality of life…[are] the reason[s] pilots are staying" (Callander, 2006). So, operations tempo might depend more on the types of missions and operations the pilots are conducting rather than just sheer workload.

Deployments

Deployments are one metric through which operations tempo might be measured. However, the effect that deployments have on a pilot's attrition decision may not be consistent across pilots, across years, or as the number of deployments changes. For example, in 1998 a pilot in an interview was explaining why he and his co-pilot were not taking the $110,000 ACP and would be joining 64 percent of his cohort in leaving active duty, stating, "I think a lot of us are just getting tired [of the number of deployments]" (Kitfield, 1998). In the same article highlighting the effects of the three- or fourfold increase in deployments for pilots since the Cold War, another pilot stated about his recent deployments to the Persian Gulf, Somalia, Rwanda, and Bosnia:

> I look at these road trips as kind of a reunion, because you see a lot of the same people you met on earlier deployments. I mean, what other job lets you take 80 of your closest friends and their luggage on the road with you, and you get to land on short runways and throw 20,000 pounds out the back of your aircraft? (Kitfield, 1998)

Just as in operations tempo, the effect of deployments may be dependent on other pilot characteristics, such as marital and children statuses. Likewise, the effect of deployments may also depend on the type of the missions or operations that the pilot conducts, which is closely linked to the type of aircraft the pilot flies. This helps explain how forward-based abroad units had high retention rates while stateside-based units had lower retention rates throughout the 1990s (Kitfield, 1998).

Aircraft Type Flown

As previously hinted at, the type of aircraft an individual flies may not only directly impact the pilot's decision, it may also influence the impact other characteristics may have on the pilot's decision (i.e., the impact of deployments on pilot attrition for fighter pilots may differ from impact of deployments on pilot attrition for tanker pilots). Specifically, a 1993 study found that pilots with more specific skills (flying fighters, bombers, and helicopters) generally have lower attrition rates compared with pilots with more general skills (flying mobility aircraft) (Stephen P. Barrows, 1993). This may be due to the phenomenon in human capital theory whereby turnover rates are inversely proportional to the specificity of training received (Brum, 2007).

It may also be possible that different communities place different emphases on the attrition of their pilots. For instance, "[t]here is a…bias against the airlines in the fighter community with fines assessed for using the 'A' word" (Drinkard, 2014). Moreover, pilots may be sorted into communities based on characteristics correlated with their preferences for airline jobs.

It may also be due to how transferrable a pilot's skills are from their military aircraft to a civilian aircraft. A KC-135 is essentially a Boeing 707 airliner. Hence, a KC-135 pilot may be able to get qualified as a major airline pilot more seamlessly than a B-2 pilot. Whatever the reason, it may be appropriate to separate pilots based on their aircraft community when exploring both pilot attrition outcomes and the impact other characteristics have on pilot attrition.

Pay

Air Force pilot salaries have been lower than major airline pilot salaries since at least the Vietnam War (Lt Col Daniel L. Cuda, 1994; RAND Corporation, 2013; Future & Active Pilot Advisors, 2013b). While it might not be possible for the Air Force to compete with major airline salaries, it still might be worthwhile to measure the relative difference between an Air Force pilot's base pay and what the major airlines offer (William J. Dalonzo, 1999).

Variation in base pay is generally due to three main factors for Air Force officers. First, their rank and years of service determine their pay grade; second, the amount of the annual military

pay raise; third, inflation. From 1972 to 1999, no annual military pay raise kept pace with the yearly inflation as measured by the CPI, but from 1999 to 2012 each year's military pay raise has been greater than the rate of inflation (Andrew Feickert; Stephen Daggett, 2012). As a means of comparison, the average base pay of a major with 10 YOS increased by 56 percent, while major airline pilot salaries increased by about 15 percent from 1999 to 2009 (Dale W. Stanley III, 2012). From 2001 to 2012, major airline salaries mainly kept up in value with the CPI, even through 9/11 and the Great Recession (Darby, 2013b). However, if the airlines continue to recover, a 30–35 percent bump in major airline pilot pay would not be unexpected (Darby, 2013b). Since variation in military pay and variation in major airline salaries are not consistent, and the relative size in the gap between the two has been changing, it might be helpful to include both basic pay and major airline pay in a model, since pilots internalize not only the amount they are currently receiving but also the amount they might receive should they begin flying for a major airline.

Other Benefits

While many of the benefits Air Force officers receive may influence their attrition decision, the benefits themselves may be hard to quantify and even harder to model. Active duty Air Force pilots accrue 2.5 days of leave every month, can shop at commissary and base exchanges for lowered costs, receive free dental and medical care, have access to a wide variety of family support programs, and are offered many—often times free—morale, welfare, and recreation activities (Barrows, 2002). Many of these services not only help compensate service members and their families for their service, they may also help to alleviate or address some of the burdens and stresses that come with active duty life.

However, it may be hard to model the effect of these benefits on pilot attrition, since there does not exist sufficient variation in the benefits. Also, many of these benefits do not translate neatly to quantitative metrics. Lastly, incorporating these benefits into a model is further impeded by how drastically the benefits may depend on an individual pilot's base, squadron, family, personal preferences, and many other factors. The benefits themselves are probably greatly inconsistent in their effects on a pilot's decision.

Parting Thoughts from Interviews

In conducting interviews with former and current active duty Air Force rated officers, a number of relevant issues came to light.[7] It may be helpful to break up the comments by the interviewee, as some of the information is best interpreted within the entirety of the individual's comments:

- According to one interviewee, there are three main reasons pilots in the 1970s and 1980s were leaving active duty.[8] First, the pay disparity between the Air Force and the major

[7] Please see appendix for list of general interview questions.

airlines was huge. Second, pilots that got out of active duty often did so because they felt they were not flying enough. Third, the adjustment from combat to peacetime brought on a change in the operational environment that many pilots did not like. In combat, their focus was less on rules and more on the mission, and this engendered an environment with a lot of responsibility and leeway that some pilots thrived within. Pilots wanted the "fly hard, play hard" lifestyle to continue, but for many of them the peacetime environment changed that lifestyle.

In general, the things that keep a young fighter pilot happy today kept them happy 50 years ago. They need a good airplane to fly often, and to feel as if they have the authority to challenge the leadership to do the job well. But if the pay differential increases too much, the pilot is not flying a lot, or their family is not happy, they will get out. Many will even get out for equal pay if the civilian environment affords them more opportunities to fly and keeps their family happier. If the pilot keeps coming home at the end of the day and they are not happy, the family will begin to wonder why they are all making sacrifices if their spouse or parent isn't even happy.

One thing the Air Force has going in terms of retention management these days, is that airline flying may not be as attractive as it used to be. The pay is not as prestigious, and the pilot has to put in hours that keep them away from their family. Airline jobs are different, but overall they have to be more attractive than an Air Force job in order for pilots to leave the Air Force.

One thing the airlines may have going for them, is that pilots these days are tired. They're worn out. If airlines present the carrot, whether that is better pay or a better lifestyle for the families, the active duty pilots will bite.

- According to the next interviewee, a lot of extra duties have begun to pile on pilots, as officers, and that may contribute to some pilots seeking an exit from active duty.[9] The number of temporary duty assignments (TDYs), the additional amount of paperwork, Professional Military Education (PME) programs (both correspondence and in-residence), and graduate degrees are all tasked for pilots to shoulder in addition to their flying duties. Many individuals are completing these tasks to just check a box and have no interest in making general officer. These duties may not be necessary for many pilots, as the Air Force could split the pilot career into two tracks where one completes all the duties and is on a leadership track, while another track is without a lot of those duties and is for individuals who want to stay in the cockpit and fly for their career. A lot of pilots might be interested in staying on active duty for a flying track, regardless of what kind of salaries the airlines are offering.

  Other possible ways to improve pilot retention revolve around ways of improving family stability. Making TDYs and deployments more predictable can go a long way in improving family quality of life. A lot of pilots would rather make less money and have more family stability while staying on active duty than go fly for the airlines. But when push comes to shove, if the family stability is not there, it is hard to justify staying on active duty.

[8] Proceeding paragraphs from interview with (Anderegg, 2013)

[9] Proceeding paragraphs from interview with: (Judkins, 2013)

The Air Force has a habit of just tossing money at retention problems. That may help retention to some degree, but that just masks some of the issues. If the airlines start to hire, active duty pilots may view that as an opportunity to escape from some of the issues.

- Another interviewee witnessed the huge pilot exodus of 1997–2001, and attributed a lot of it to the huge economic incentives being offered by the major airlines.[10] Once a few pilots started being hired in 1997, other pilots saw a path into the major airlines and jumped at the chance. Many pilots were calculating their own financial break-even points, where it made sense to exit active duty for a major airline job before the point, and after the point the pilot might as well stay on until retirement. In 1997 and 1998, that breakeven point was about 18.5 years. It became a frenzy where many pilots with around 15 YOS were jumping in line to leave since seniority of even a couple months could make a huge difference in the timing of whom would be hired.

  The Air Force responded by ostracizing pilots that had any desire of flying for the major airlines. These individuals were taken off flying duties (some just shy of flying-hour thresholds required in the major airlines), not allowed to wear flight suits, and given other duties they might not like. For example, some of the first pilots in the predator program were those that refused the retention bonus. In general, there was a stigma attached to refusing the bonus by all the retaliatory measures imposed. Coincidentally, many of those pilots exiting in the late 1990s were coming back to the Air Force in 2002 attempting to get back into active duty.

  Lastly, it seemed the dynamic between the hiring frenzy and the Air Force's response changed some of the aircraft communities' cultures. For example, in the late 1990s the highest-ranked graduates were selecting mobility platforms, especially KC-10s, since they were then extremely valuable to the airlines. The Air Force responded by attempting to create a fighter mentality within the Air Education and Training Command (AETC) and had a lot of mid-level fighter pilots become instructor pilots. These fighter pilots did not enjoy becoming instructor pilots and they became miserable and looked to get out. The plan backfired.

- Another interviewee discussed the current pilot inventory, stating how there is a glut of mobility pilots, and the Air Force does not know what to do with all of them (Schiefer, 2013). This excess may be causing some mobility pilots to miss out on opportunities necessary for career progression. Additionally, the Air Force will never be able to monetarily outbid the airlines—the airlines will just raise ticket prices and pass this on to major airline pilot salaries to increase the financial incentives for pilots to leave active duty for major airline jobs.
- One interviewee spoke to both the difference in how the major airlines value pilots of different communities at certain levels of flying hours, and how those pilots within those communities value continuing to fly on active duty (Drinkard, 2014). Fighter pilots may get hired with less flying hours than mobility pilots because whatever hours they do receive are usually a more intense employment of their skills (taking off, landing, training engagements). In general, there is also no extra training required for fighter pilots as compared with all other Air Force pilots. Lastly, the fighter pilot job may produce more

[10] Proceeding paragraphs from interview with: (Manion, 2013).

intrinsic and extrinsic rewards than other flying communites' jobs may offer in that flying a fighter feeds the ego like no other job—especially a major airline job—can.

Recap on Influential Factors

There are clearly a number of factors that may influence pilot attrition. There are, however, limits as to what factors may be included in building a model to predict pilot attrition. Some factors, such as barring pilots from wearing flight suits, are hard to observe, do not provide sufficient variation for modeling, and are hard to predict in the future. Other factors, such as the number of major airline hires, are relatively easy to observe, have achieved large relative levels of variation in recent years, and have estimated future values that while being anything but certain, are nonetheless reasonable projections to use in predicting future active duty Air Force pilot attrition. The next chapter focuses on a historical analysis, using factors that generally fit the three criteria needed to reliably create a model that will ultimately be used in predicting future attrition.

Chapter Three: Historical Analysis

Overview

While the previous chapter helped identify factors influencing individual attrition decisions that are consistent at the aggregate level and across the years, the intention of this chapter is to test those assumptions at the individual level and arrive at a model that is both powerful enough to explain the attrition profiles in years 1996–2012 and universal enough to be applied to a future set of years. This will not only aid in contextualizing the historical pilot attrition rates and decisions, it will also serve as the means by which future active duty Air Force pilot attrition is to be predicted.

This chapter seeks to tease out factors that influence an active duty Air Force pilot's decision to stay or leave active duty in the three years following the completion of their initial ADSC, using data from fiscal years 1995–2011. It relies on information and theory obtained in the previous chapter to guide both the construction of the model and ultimately the interpretation of the results. It is intended to be used as a predictive model in the future. Consequently, it not only has to do a good job in predicting attrition in 1995–2011, it must also use factors that in the future will either be readily attainable or will require basic assumptions upon which the results are not highly sensitive. The end model strikes a balance between these two somewhat competing requirements—predictive capability versus future prediction practicality—and hopefully achieves results that illuminate past attrition and provide a springboard to better predicting future attrition in the next chapter.

Data

The bulk of the data being used are from the Air Force Personnel Center. They provide a yearly snapshot of all pilots at the end of each fiscal year from 1975 to 2012; the analysis in this chapter focuses on data from fiscal years 1995–2011. Only observations of pilots in the first three years following completion of their initial ADSC are kept in the data. Additionally, pilots with 20 or more YOS are excluded from the data.[11] Since individuals are only observed if they remain in active duty, observing years 1995–2011 yields the active duty attrition profiles for years 1996–2012.

This longitudinal data has been supplemented with four additional data sources. First, USAF Statistical Digests provide end of fiscal year data on active duty Air Force metrics. For example, the dataset derives the total number of flying hours the regular (active duty) Air Force flew in a

[11] These two requirements are discussed later on in this section.

given fiscal year from the yearly USAF Statistical Digests. It is important to note that the final model does not include any of these larger Air Force trends or statistics as predictors.

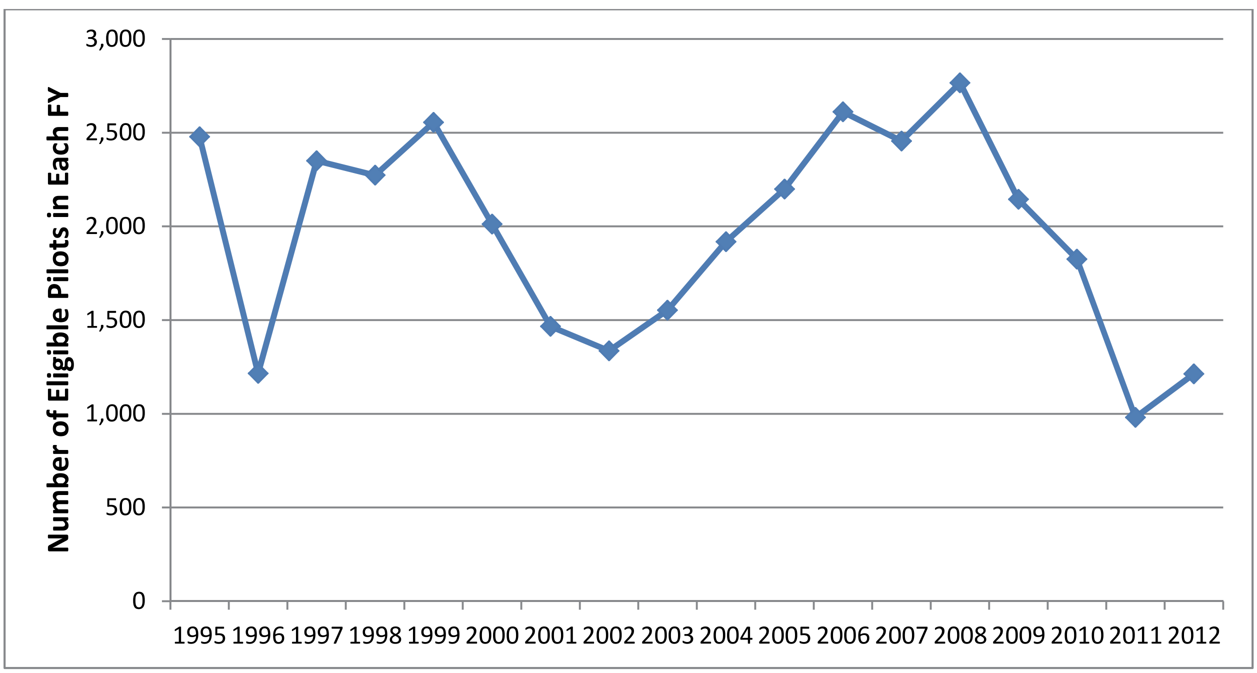
Second, the Integrated Public Use Microdata Series (IPUMS) supplies civilian pilot salary data from the yearly Current Population Survey (CPS). IPUMS-CPS is reported by calendar year, not fiscal year. This means the two types of data will be misaligned by three months.

The last two data sources are also reported by calendar year. Data from Future and Active Pilot Advisors (FAPA.aero) provides data on major airline pilot hires—both historical as well as future projections—and data from KitDarby.com Aviation Consulting gives historical major airline salaries.

Summary Statistics

There are 35,350 observations being analyzed from years 1995 to 2011. Figure 3.1 shows the total number of observations in each fiscal year from 1995 to 2011. The drop in eligible pilots in 2011 is mostly a function of the way the ADSC changes were structured, in moving from eight years to ten years. Additionally, the number of eligible pilots in each year is also a function of both the number of pilots eligible in the previous years and the attrition levels in those years. For example, the large increase in attrition rates following years 1998 and 1999 contributed to fewer pilots being eligible to leave in 2000 and 2001.

Figure 3.1: Number of Eligible Pilots in Data, by Fiscal Year, 1995–2012



The numbers of pilots in each year of their ADSC window is reasonable, considering that any attrition occurring in year 0 means less pilots will become observations in year 1, and any attrition in year 1 means there will be even less pilots for year 2 (Table 3.1).

Table 3.1: ADSC Window Tabulation

ADSC Window	Freq.	Percent
0	13,954	39.47%
1	11,197	31.67%
2	10,199	28.85%
Total	**35,350**	**100%**

The majority of pilots in the sample are commissioned via the USAFA, followed closely by ROTC. The majority of pilots in the "Other" category are commissioned via Officer Training School (OTS), and subsequently the model refers to this category as OTS (Table 3.2).

Table 3.2: Commissioning Source Tabulation

Commissioning Source	Freq.	Percent
ROTC	14,893	42.13%
USAFA	17,076	48.31%
Other	3,381	9.56%
Total	**35,350**	**100%**

About half of the pilots in the sample were mobility pilots (Table 3.3). About a third of the pilots were fighter pilots. Bomber pilots were the next most populated category. Pilots are broken down further by the total number of hours they have flown in their career. The threshold between the groups is between 2,000 and 2,400, depending on which aircraft type they fly. Pilots below the threshold are in the "0" group, and pilots above the threshold are in the "1" group. This will be revisited in more detail.

Table 3.3: Aircraft Type by Flying Hours Tabulation

Platform Type	Flying Hours Bin[12]		
	0	1	Total
Fighter	8,850	2,009	10,859
Bomber	1,553	1,064	2,617
Mobility	7,716	10,716	18,432
CSAR	955	726	1,681
Other	635	1,126	1,761
Total	19,709	15,641	35,350

Methodology

The modeling approach taken in this chapter relies heavily on survival analysis theory. This type of analysis goes by many names: duration analysis to the economist or event history analysis to the sociologist. Whatever the name, this type of analysis is chosen because its methods apply very well when the occurrence and timing of events are being investigated (Allison, 2010). In this case, the event of interest is pilot attrition. Survival analysis assumes events are stochastic in time. Thus, the time until a pilot leaves the Air Force is treated as a random variable. This means that the probability of any individual leaving at any given year is also a stochastic event. This assumption is especially important for future predicted attrition, modeled in the next chapter.

Using survival analysis requires picking a time scale and time origin. For the data chosen, the scale is one year, and the observations are snapshots taken at the end of every fiscal year. The origin for each individual is the first year they have a pilot Air Force Specialty Code (AFSC) (having received their wings after pilot training and no longer having the student pilot AFSC designation). Thus, each individual can be thought of as having their own survival history, where their observations are recorded as a set of discrete time observations of the individual and treated as distinct observations. These individual observations are pooled for all individuals, yielding a survival history of all active duty pilots revealing if and when pilots left active duty.

In this person-year data, there are no competing risks to worry about, since I am treating every instance and type of leaving the Air Force as the event of interest. While some of this information is censored for individuals, and is unavailable prior to 1975, the observations are treated as independent from year to year. Additionally, I am conducting analysis only of individuals during a specified window of time—the first three years following completion of their initial ADSC. Moreover, since I am not modeling years previous to 1995, I have enough observed years to ensure that censored data will not be an issue in assigning the correct time origin and therefore assigning the correct timing of each individual's ADSC.

[12] This metric is discussed in the "Variables Included" section. It separates pilots into two bins by total number of career flying hours.

Maximum likelihood methods are very well suited for handling this type of data and where many of the covariates depend on time (Allison, 2010). Furthermore, since the event of interest yields a dichotomous dependent variable (either the pilot stayed in or they left), logistic regression becomes the model of choice for a variety of reasons. For one, its coefficients can be reported as odds ratios (more on this below). The model also has desirable sampling properties, which will be taken advantage of in this chapter when pilots and data of different groups are pooled together. Lastly, a logistic model is desired here because of its functionality in handling covariates that have multiple unordered categories impacting the event.

Specifically, the logistic model gives estimates of discrete-time proportional odds, and I can take advantage of its preferred use with large samples and heavily tied event times data (Allison, 2010). I will presume to know only that a recorded event means the event occurred sometime between this year's observation and next year's observation.

Let A_{it} be the conditional probability that pilot i leaves the Air Force sometime between time t and time $t+1$, given that they are still in the Air Force at time t. Then the logistic regression equation is:

$$\log\left[\frac{A_{it}}{1-A_{it}}\right] = \alpha_1 + \beta_1 x_{it1} + \cdots + \beta_k x_{itk}.$$

A_{it} is related to the covariates $\overrightarrow{x_{it}}$ by the coefficients $\vec{\beta}$.

In order to make use of logistic models, it is important to know how to interpret and understand the coefficients. In this dissertation, odds ratios will be used in lieu of logistic regression coefficients. That is, each odds ratio is instead reporting e^{β}. For categorical covariates, the interpretation of an odds ratio is easy. For example, if I included a variable indicating if the individual was female, a value of 1.3 means the odds for females leaving the Air Force are 1.3 times the odds for males. Looked at another way, the odds for females leaving are 30 percent higher than the odds for males. In basic terms, an odds ratio of less than one means that variable is predicting someone as less likely to leave the Air Force; an odds ratio of one means that variable is predicting no influence on someone to leave the Air Force; and an odds ratio of greater than one means that variable is predicting someone as more likely to leave the Air Force. These odds ratios have to be taken with a grain of salt, since they are to be interpreted given every other covariate is held constant.

For quantitative variables, I can use the odds ratio to find out the percent change in odds for each 1-unit increase in the variable, by calculating $100(e^{\beta}-1)$. For example, an odds ratio of 1.1 for a variable measuring an individual's age means that every year older an individual becomes, they are 10 percent more likely to leave the Air Force. Again, all else is held constant.

Cohort Analysis

The analysis conducted in this chapter focuses on individuals in the first three years following completion of their initial ADSC. For example, an individual completing pilot training before

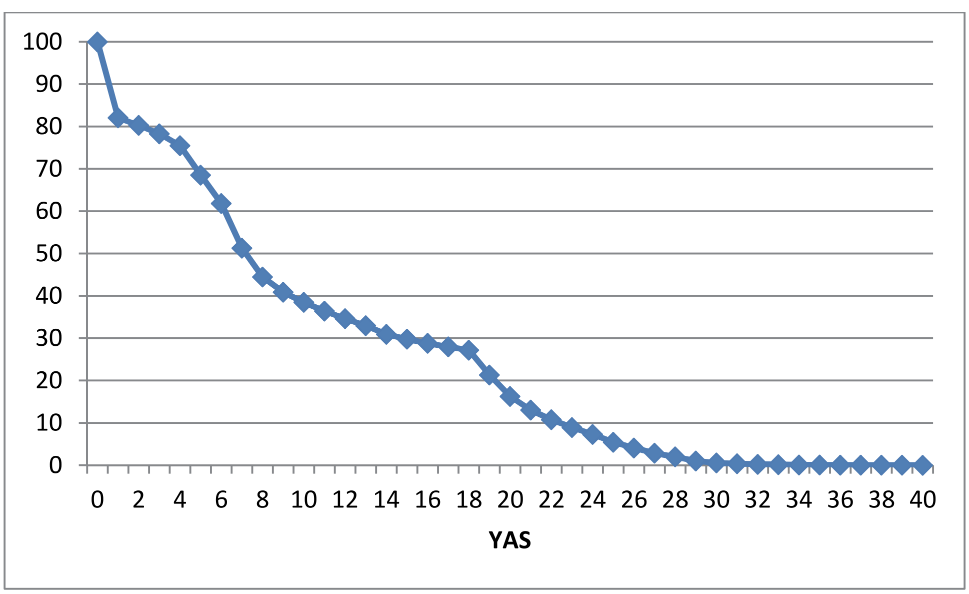
1987 would be included in this analysis at years six, seven, and eight of aviation service. Thus, the first year individuals appear in the database and which cohort they belong to both help in determining each pilot's eligible "ADSC window." The window was chosen since the largest proportion of losses the Air Force may care about occurs within this timeframe. The Air Force is also less concerned about losses occurring after retirement.

Because of the six different ADSC cohorts, this chapter first separates the pilots and their observations into six different cohorts for exploration. Pilots are first given a "cohort-year." This is the year they first appear in the database, and is presumably their first year out of pilot training. The database starts in 1975. Consequently, it is easy to assign cohort-years for pilots entering into the database after 1975.

Survival analysis is heavily dependent on the timing of events. Pilots become eligible to leave active duty when their ADSCs are completed. Thus, in order to get unbiased results from a survival analysis on pilot attrition, it became prudent to first separate pilots into groups based on their ADSCs. This brings about the creation of six different cohorts. Initially, this also prompted the creation of six different logistic models—one for each cohort. For succinctness, the cohorts were eventually combined, and analysis was conducted on all individuals in their ADSC window, regardless of which cohort they belonged to. This was justified because the results remained relatively consistent moving from six models to one model, and the hazard rates—the chances a pilot would leave active duty any given year—within the ADSC window were also similar between cohorts.

Cohort 1 is composed of cohort-years 1976–1987, representing a cohort that had an ADSC of six years following pilot training. Figure 3.2 shows that cohort's survival curve.

Figure 3.2: 1976–1987 Cohort (6-Year ADSC) Survival Curve, by Year of Aviation Service



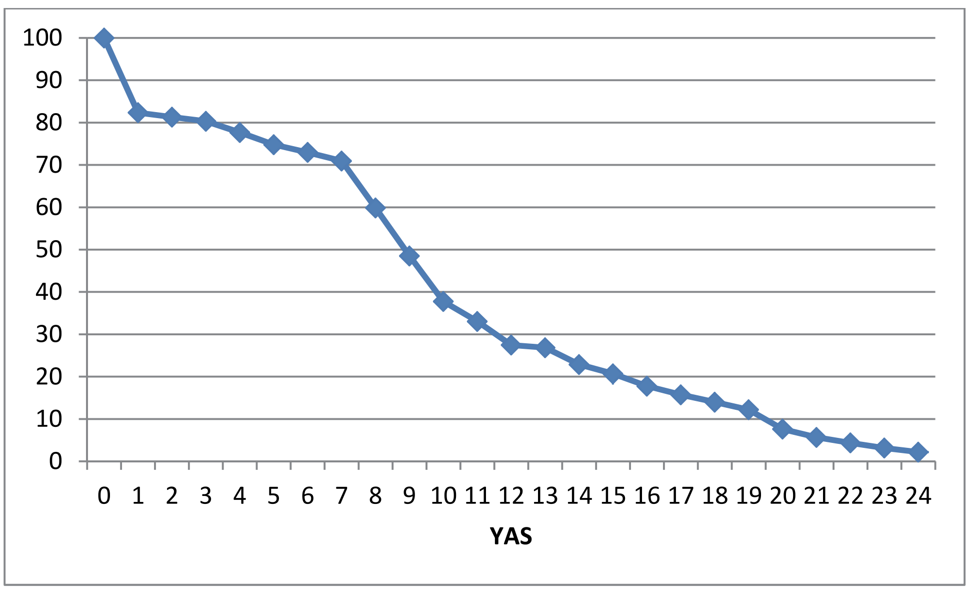
If the cohort started with 100 individuals in YAS 0, the graph plots the number remaining for each additional YAS. The large drop in pilots from YAS 0 to YAS 1 is attributed to members completing training and leaving active duty for Guard assignments. This cohort had reached approximately 50 percent retained by YAS 7.

Cohort 2 is composed of cohort-year 1988, which had an ADSC of seven years following pilot training. This cohort-year was a transition year, as the Air Force moved the ADSC from six to eight years over the course of two fiscal years (Table 3.4). Figure 3.3 shows the cohort's survival curve.

Table 3.4: ADSC Requirements by Cohorts

Fiscal Year	ADSC
Pre-1987	6
1987	7
1988–1999	8
2000–present	10

Figure 3.3: 1988 Cohort (7-Year ADSC) Survival Curve, by Year of Aviation Service

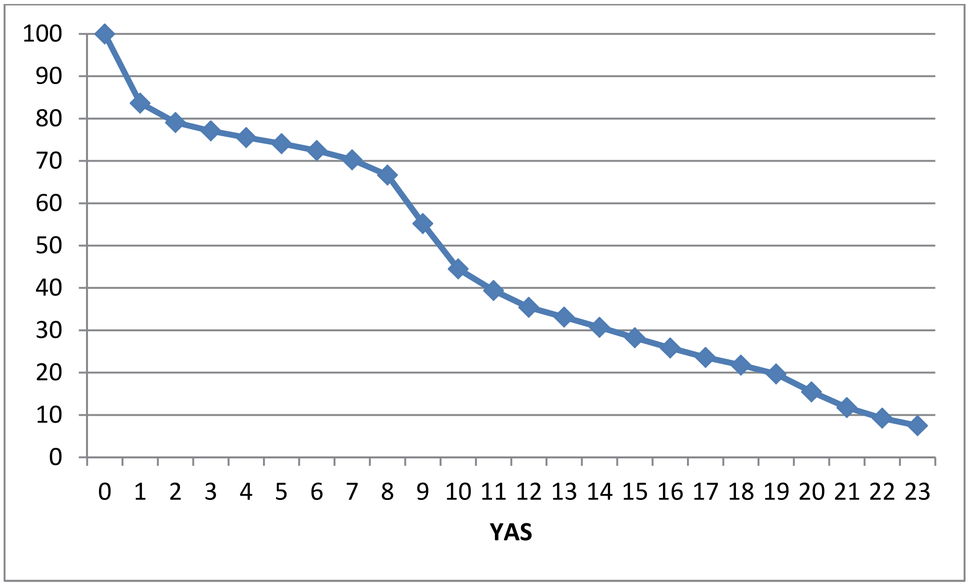


This cohort has even more sharply defined kinks in its survival curve, at places one would expect. An ADSC kink occurs at the end of the cohort's initial ADSC, where the survival curve becomes steeper for the next three years as individuals become more likely to leave active duty. After this wave of pilots leave following the completion of their initial ADSC, the survival curve flattens as proportionately more pilots in this cohort began staying for additional YAS. This cohort had reached approximately 50 percent retained by YAS 9.

As expected, the increase in ADSC by one year to eight years for cohort-years 1989–2000 produces a kink following the initial requirement that is a year later than the previous cohort

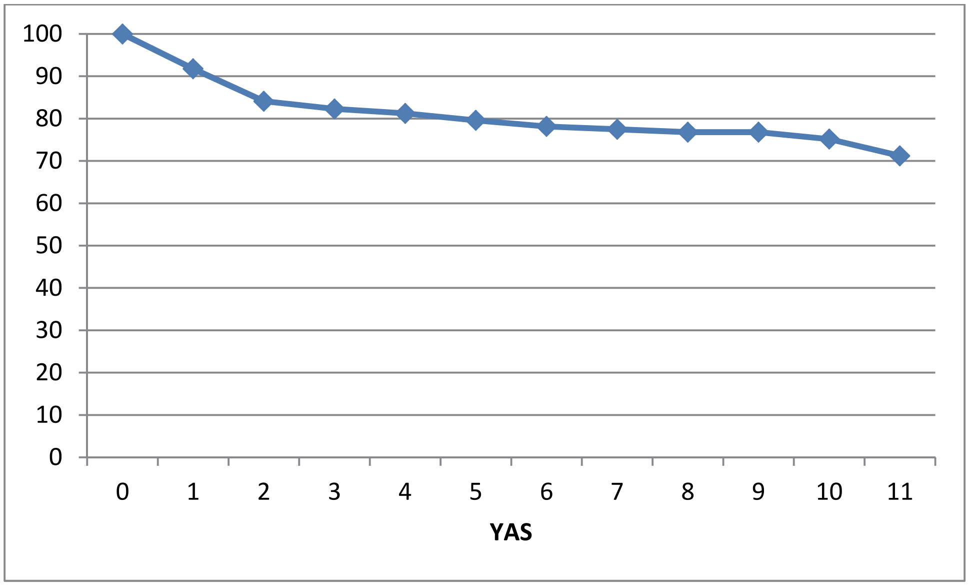
experienced (Figure 3.4). This time, the next kink occurs after two years, as pilots became more likely to continue their active duty service at the same YAS as last year's cohort, even though the ADSC kink occurs at different YAS for both cohorts.

Figure 3.4: 1989–2000 Cohort (8-Year ADSC) Survival Curve, by Year of Aviation Service



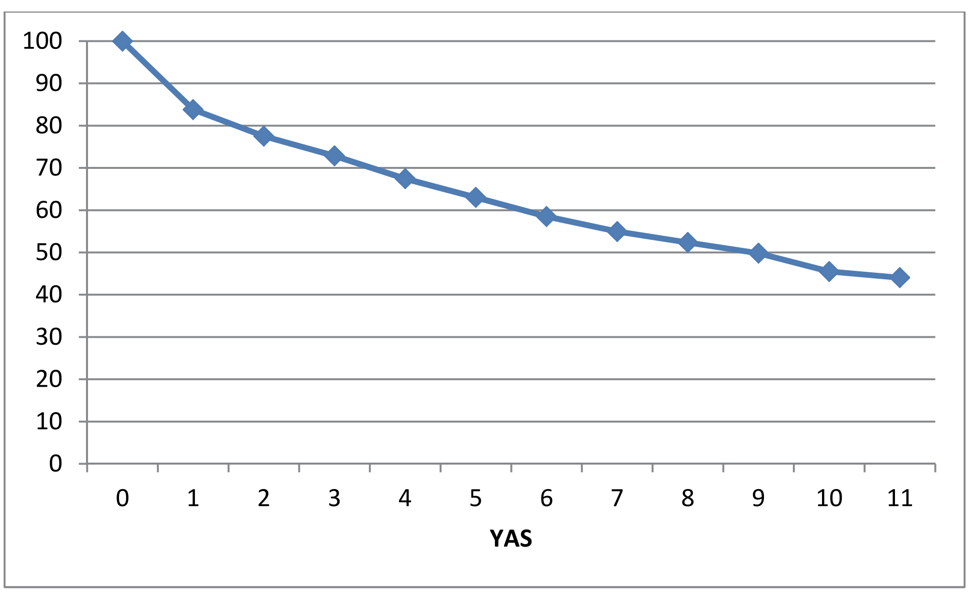
USAFA graduates in cohort-years 2001–2002 continued under an 8-year ADSC, while non-USAFA graduates in cohort-years 2001–2002 were subject to the increase in ADSC to ten years. While the data available give the opportunity to witness the ADSC kink for USAFA graduates (Figure 3.5), as they fulfill their initial ADSC and are eligible to leave active duty, it does not give the opportunity to witness the non-USAFA graduates' entire ADSC window.

Figure 3.5: 2001–2002 USAFA Cohort (8-Year ADSC) Survival Curve, by Year of Aviation Service



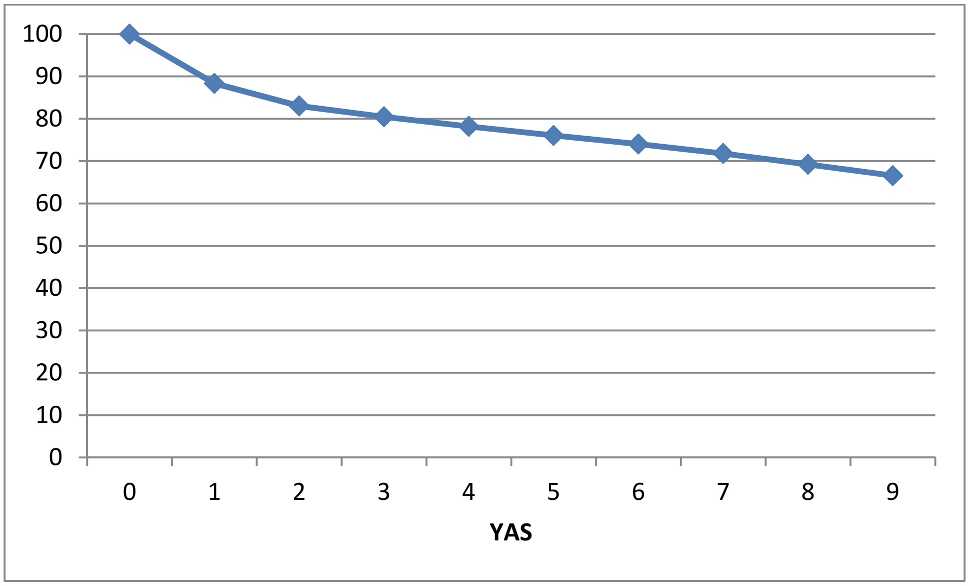
In the 2001–2002 cohort-years, USAFA graduates do have a shallower survival curve as compared with non-USAFA graduates (Figure 3.6). Separating these cohort-years also reveals the effect of non-USAFA graduates completing training requirements and transferring to Guard duties as the drop between YAS 0 and YAS 1 is much more pronounced for non-USAFA graduates.

Figure 3.6: 2001–2002 Non-USAFA Cohort (10-Year ADSC) Survival Curve, by Year of Aviation Service



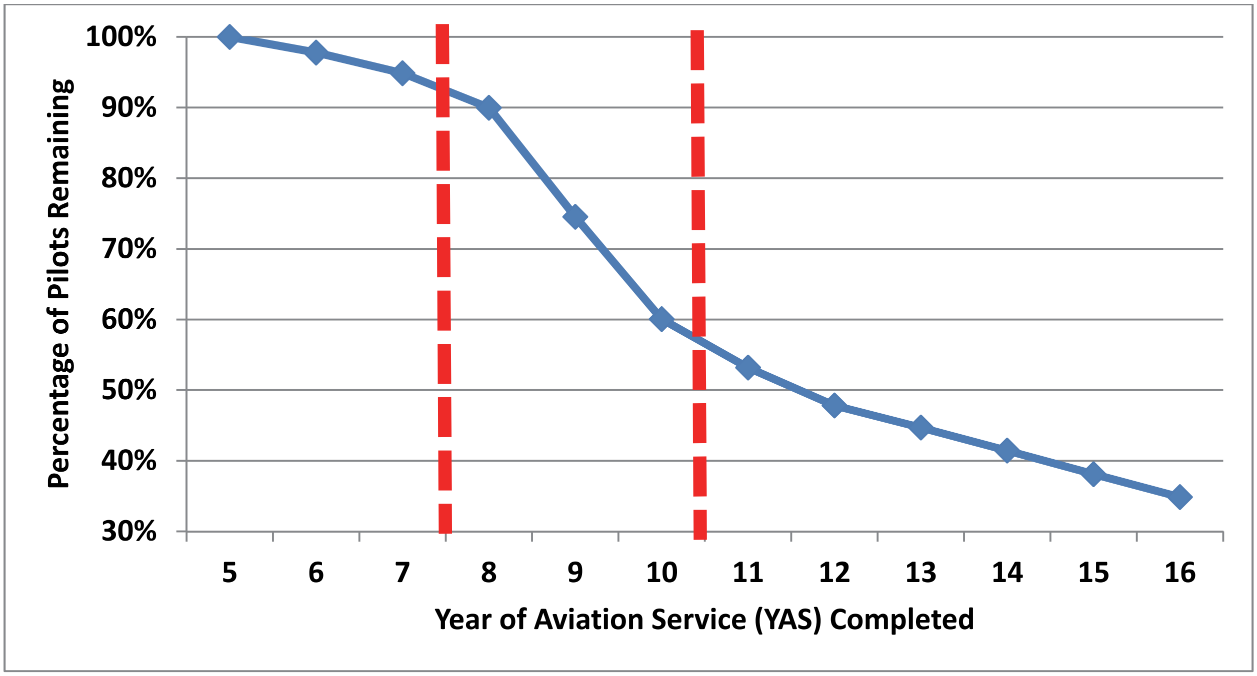
The survival curve in Figure 3.7 shows the final cohort, composed of the 2003–2011 cohort-years. This cohort has a 10-year ADSC, meaning their ADSC kink had not yet been witnessed. This cohort retained a higher percentage of individuals at YAS 9 than all previous cohorts besides the 2001–2002 USAFA cohort.

Figure 3.7: 2003–2011 Cohort (10-Year ADSC) Survival Curve, by Year of Aviation Service



It is fairly obvious that much of the attrition before retirement occurs in the three-year window following completion of the initial ADSC. For example, the survival curve shown in Figure 3.8 for the 1989–2000 cohort-years for YAS 5–16 shows a significant proportion of pilots exiting active duty in the first three years following completion of the initial ADSC. This is the main reason this dissertation focuses on pilots in their ADSC window, because this generally is when the largest proportion of pilots leave active duty prior to retirement.

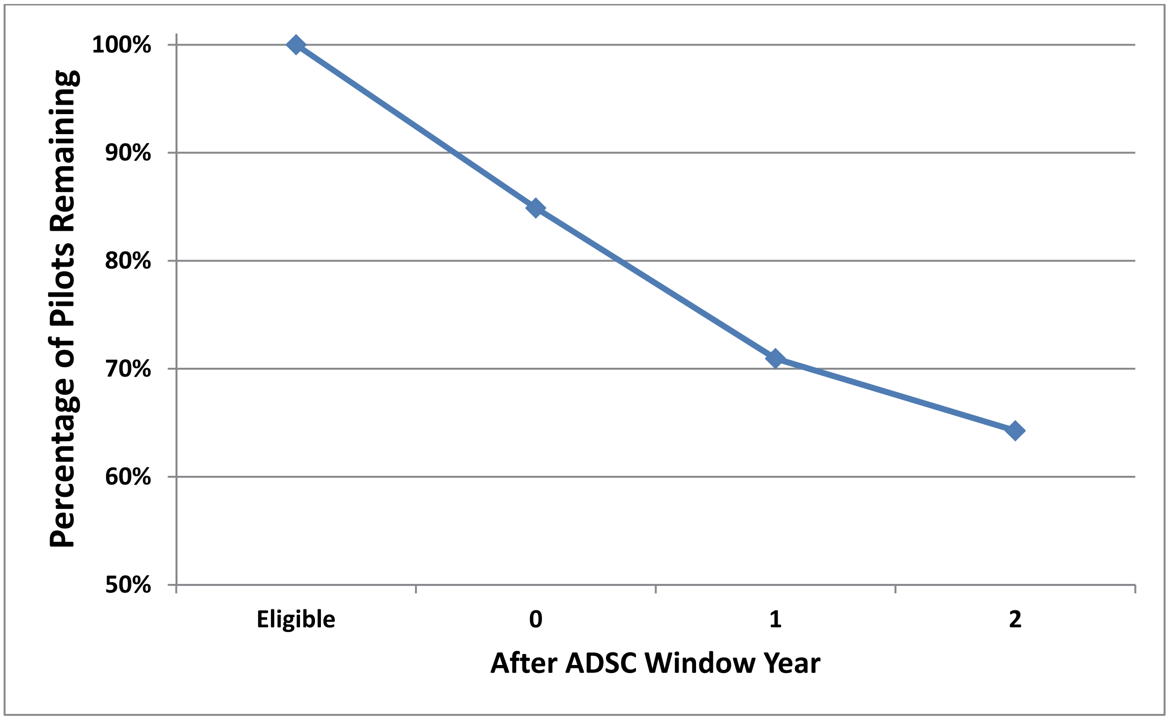
Figure 3.8: 1989–2000 Cohort (8-Year ADSC) Survival Curve, by Year of Aviation Service, with ADSC Window



Note: Numbers are as a percentage of pilots present after completing five YAS.

After the cohorts are pooled together, the resulting sample contains individuals with years 0, 1, and 2 after their initial ADSC expired. Figure 3.9 shows the survival curve of individuals in their ADSC window. If there are 100 eligible pilots in an ADSC window year of 0, then Figure 3.9 shows the survival curve for individuals after each year of their ADSC window. After year 0, about 85 percent of the individuals remain. After year 1, about 70 percent remain, and after year 2 about 65 percent. These three years represent the “steepest” sections of each cohorts’ survival curves.

Figure 3.9: 1976–2011 Cohorts' ADSC Window Survival Curve



1995–2011 Exploration

Figure 3.10 plots the total attrition for active duty Air Force pilots with less than 20 YOS in their ADSC window and the number of major airline hires in each year. The relationship between hiring and attrition is clear, and clearly warrants further investigation and inclusion in the model. It might be more appropriate to our modeling setup to instead look at the relationship of major airline hiring to attrition proportions.

Figure 3.10: Major Airline Pilot Hiring Versus Air Force Pilot Attrition

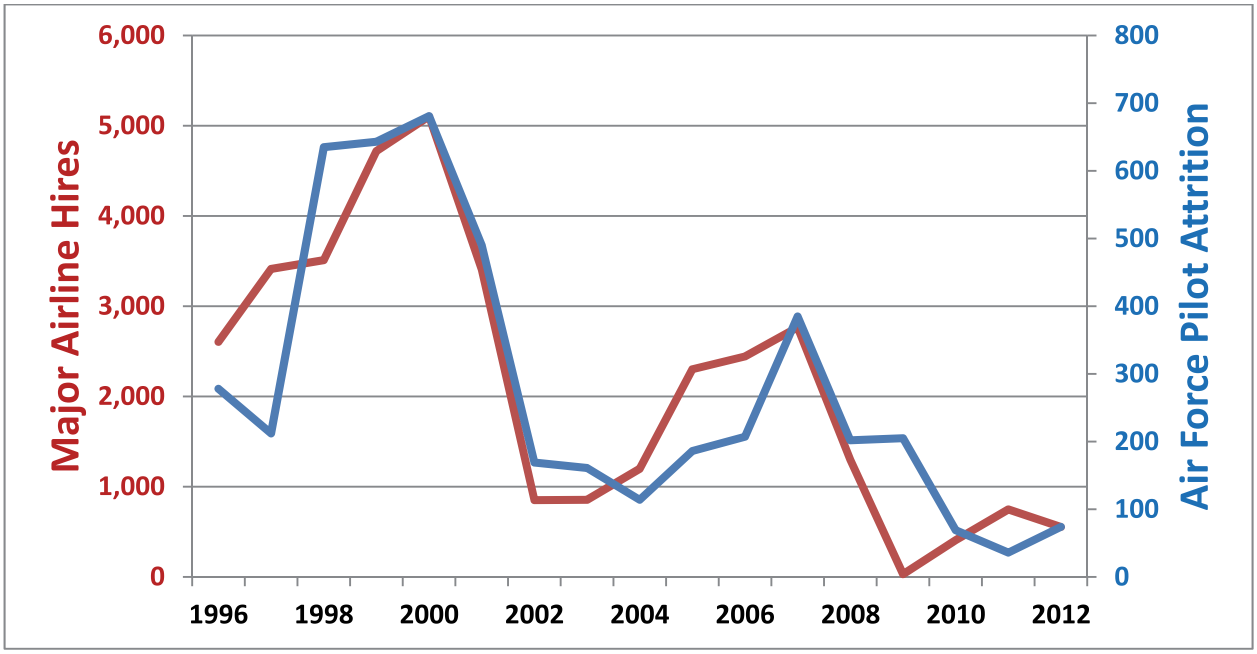
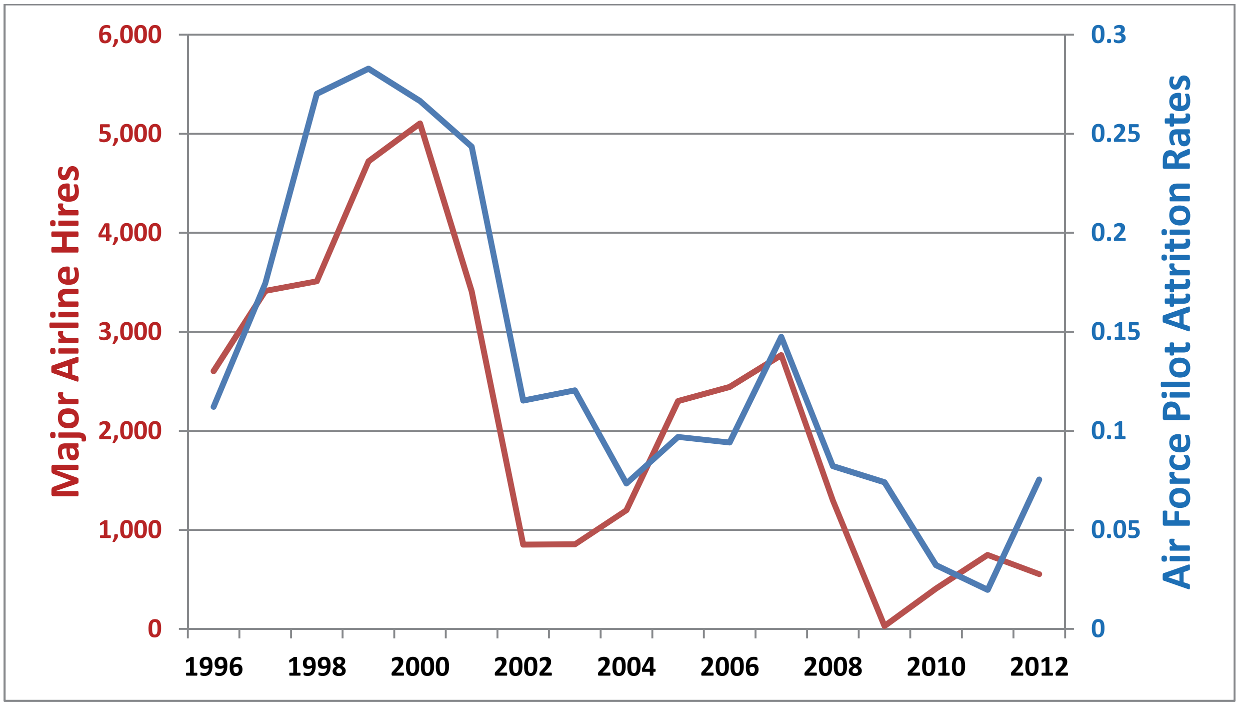


Figure 3.11 shows the relationship between major airline hires and attrition proportions of active duty Air Force pilots with less than 20 YOS in a three-year window following completion of their initial ADSC. As airline hires went, so too went the proportion of pilots leaving active duty.

Figure 3.11: Attrition Proportion and Major Airline Hires



It appears that the initial setup of using a logistic regression to generate predicted probabilities of attrition by modeling the effect of major airline hires on Air Force pilot attrition is well-suited.

It also appears that attrition may be dependent on the type of aircraft the pilot flew. Mobility pilots appear to sustain the highest attrition rates, while combat search and rescue (CSAR) pilots appear to have lower attrition rates (Figure 3.12).

Figure 3.12: Attrition Rates, by Aircraft Community

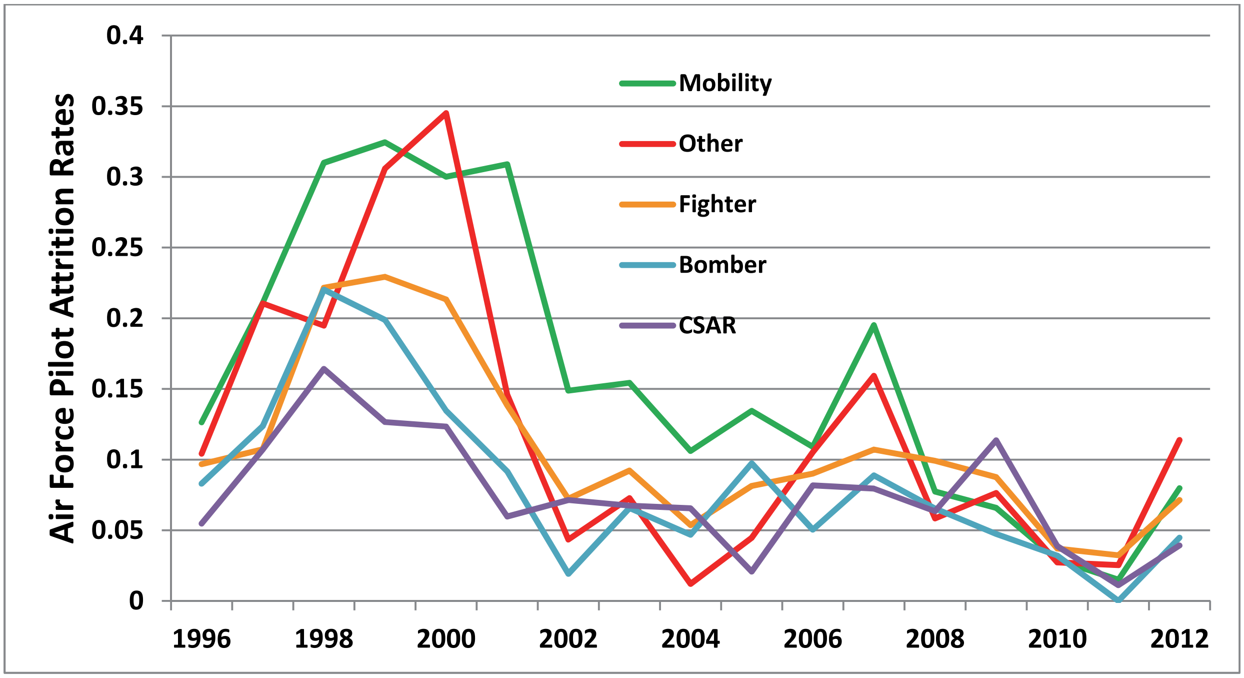
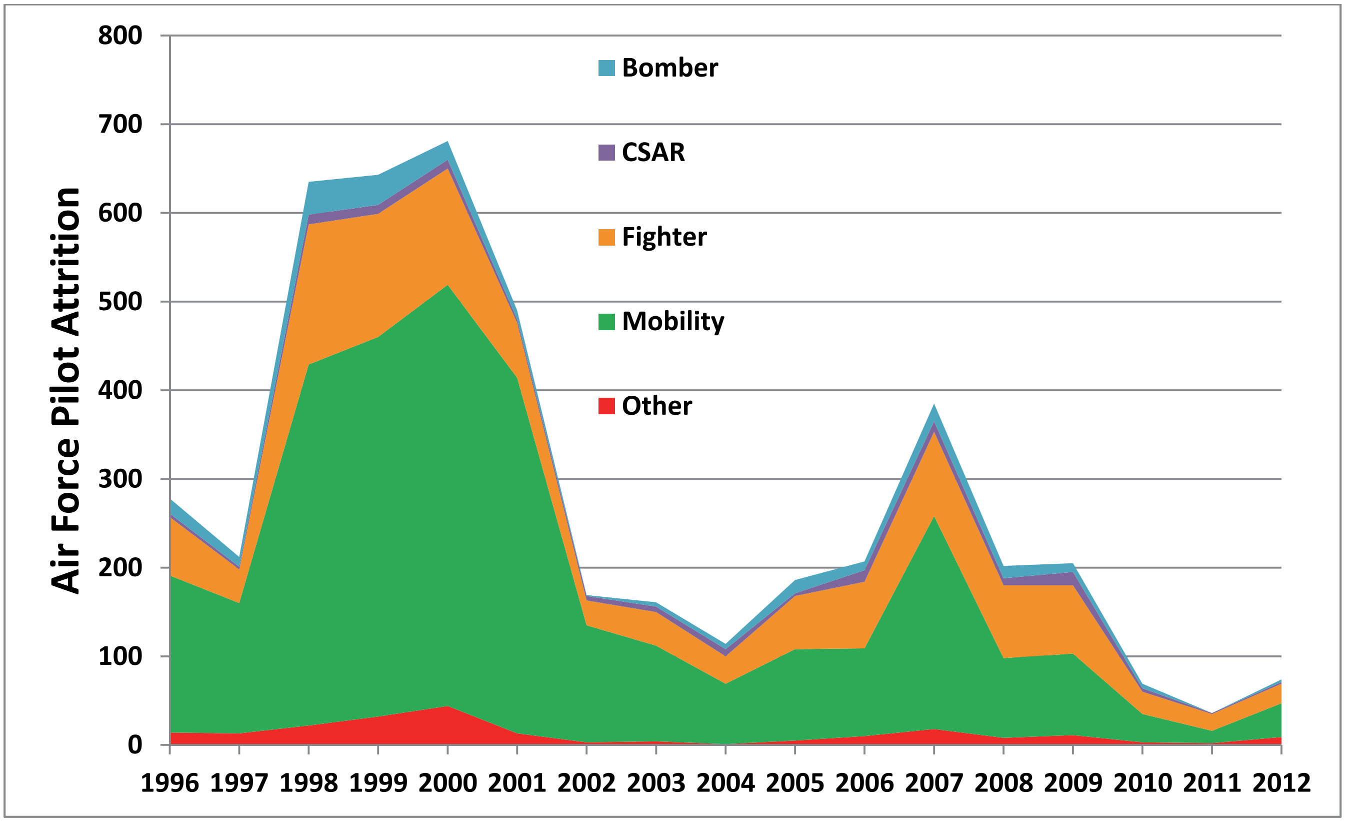


Figure 3.13 shows how each platform contributed to total attrition numbers. The higher attrition rates combined with the larger stock of mobility pilots allowed total mobility pilot attrition to balloon during periods of higher-than-usual major airline hiring. While the effects of hiring also appear to show up in the total attrition of other aircraft types, the mobility community bore the brunt of pilot attrition in periods of higher-than-usual major airline hiring. The fighter community witnessed the next-highest total attrition numbers.

Figure 3.13: Total Attrition, by Platform Type



In the model, trainer pilots are re-designated in the "Other" category. Initially, these pilots had their own category since the late 1990s had many trainer pilots in their ADSC window, and these pilots had high attrition proportions. However, compared with other aircraft types, they would be barely noticeable in Figure 3.13. Even more, in the future there will be proportionately less trainer pilots than in the late 1990s.

Model Specifications

It is with these trends in mind that we turn to the actual model. The model is the result of trying many different model specifications, and it is simple enough to understand and hopefully powerful enough to be used in predicting attrition into the future. Many preliminary models had controlled for the cohort and YAS for each individual. In the end, only the individual's ADSC window year is included as a control in this respect. The rest of the covariates can be classified as demographic information, military career information, or airline information. The model is run separately on pilots of different aircraft types. The reason for this is that the effect of any one variable on the average pilot may be different depending on the type of aircraft flown. For example, the effect of major airline covariates on CSAR pilots may differ from the effect on mobility pilots, since mobility pilots are much more likely to be hired by a major airline than

helicopter pilots. The next section includes some discussion on the variables included and the reasons for doing so.

Variables Included

Individuals in the data are either in year 0, 1, or 2 of their ADSC window. An individual's decision may change depending on how long it has been since his or her initial ADSC expired. For example, individuals at year 2 have already stayed two years beyond what the initial ADSC required. This may make them more likely to stay. Additionally, since the model is blind to which individuals took an additional ADSC (through the ACP), this may serve as a proxy picking up the effect of individuals who already took the bonus and cannot leave active duty.[13] The model uses a categorical variable to measure which year the individual is in. The results capture the effect of being in year 1 or year 2 as compared with being in year 0.

The model accounts for the individual's YOS in three ways. First, it includes a variable indicating whether or not the individual is within five years of retirement eligibility (i.e., has 15–19 YOS).[14] It seems likely that the closer an individual is to 20 YOS, the more likely they are to stay in for retirement benefits. In general, 15 YOS appeared a likely threshold. Second, the model includes another indicator variable denoting whether the individual has less than 10 YOS. It is possible that being less than half of the way to retirement YOS affects an individual's decision. Lastly, I simply included the variable for an individual's YOS. This measures the effect of being at each additional YOS. This might be important, since the 1995–2011 population the model is being run on has, on average, a lower YOS than the population of pilots within their ADSC window that the model will use to predict future attrition. This is where future research using data from pilots with ADSC windows beginning at 10 YAS might be helpful, since it is not known how well the effect of YOS on attrition from pilots in the 1995–2011 population will translate to future populations.

Finishing up the rest of the demographic controls, the model controls for gender, whether an individual is married, whether they have any children, the number of children they have, and whether the individual is white or non-white. The reason two variables are used for children is because the effects of having children may change as the individual has more children. For example, while an individual's decision might be affected by whether or not they have children, it also might be impacted by whether they have five children as compared with one child.

Next, the model controls for an individual's commissioning source. It treats ROTC commissioning source as the base case and measures the effect of being commissioned from

[13] I decided to construct a model that is blind to which individuals already took the bonus, since the model will also be used to predict future attrition, and it is unknown which individuals will take the bonus in the future.

[14] This is often the case for individuals who have served in the Air Force in other capacities prior to entering pilot training.

USAFA or from any other commissioning source—a majority of other sources are Officer Trainer School (OTS).

In the same way that the model controls for children, it also controls for deployments.[15] It uses an indicator variable for any deployments, and then another variable measuring the effect of additional numbers of deployments. Being deployed may affect an individual's decision through a whole host of avenues. For one, they may feel a deeper sense of accomplishment. They may feel like a more integral part of the Air Force. They may have developed higher camaraderie with other service members. Additionally, being deployed causes certain hardships on pilots and their families that may become increasingly exacerbated the more deployments they endure. These all may influence the pilot's decision.

A number of different ways and methods of accounting for military pay were included in previous model formulations. Different specifications included an individual's total military pay (including basic allowance for housing (BAH), basic allowance for subsistence (BAS), ACIP, ACP, and tax advantages). Different lifetime expected present discounted value (PDV) pay streams were calculated, including total military pay plus retirement benefits.

The end specification is not only one of the simpler possible specifications attempted, it also appears to be the best model in terms of predictive capabilities and efficiency (in the statistical sense). The model uses an individual's monthly base pay and ACIP. It also computes the effect of the PDV of the highest five-year ACP being offered to the individual. That is, the model assumes that pilots avail themselves of the option with the highest PDV offered. For example, if the pilot had the choice between choosing a regular ACP dividing payments equally over five years, or another option where they could receive 50 percent of the total value up front, they would choose the 50 percent lump-sum option, since that yields the highest PDV. The PDV assumes a 10 percent discount rate. All values were indexed to 1999 constant dollars.

The model takes into account an individual's flying hours. The model includes a variable indicating whether or not a pilot has over a certain total career flying hours threshold, where the threshold is dependent on the type of aircraft flown. This is intended to reflect the major airlines' preferences for individuals with at least a certain number of flying hours that also depends on the type of aircraft flown and how competitive the individual is for a major airline job relative to other pilots in that aircraft type. All thresholds are set to at least 2,000 career flying hours. The model also uses an individual's total combat flying hours. This may, in concert with deployments, help account for how much the pilot has been flying the types of missions some of them may prefer (combat missions).

The next variable measures the number of year, out of the past four years, that a pilot had less than 75 first pilot flying hours. This may serve as a proxy for the number of years a pilot was in a nonflying billet, or just indicate years in which a pilot was not able to do much flying at all for

[15] There may be an issue with deployment data being incomplete, or missing all together for some individuals. This is discussed in the "Predictions" section.

whatever the reason. This measure is included because pilots appear to care about whether or not they are able to fly, and whether or not they are able to do so as the pilot in command (the first pilot).

The last three variables help measure the pull a pilot may feel to leave active duty for a major airline job. One variable measures the average yearly wage of pilots surveyed in the Current Population Survey (CPS). It includes pilots in both the regional and major airlines. The next variable is what prompted this dissertation: It measures the number of annual major airline hires. The last variable measures the average monthly salary of a major airline captain with more than 12 YOS.

There may be concerns that major airline hiring is endogenous with the outcome variable (active duty Air Force pilot attrition). This concern is somewhat alleviated in the current model specification, as major airline hiring in one calendar year is used to predict attrition that occurs in the next fiscal year. But, since there is a potential three-month overlap (the last three months of the calendar year: October, November, and December) of major airline hiring and the time in which an Air Force pilot might have left active duty (the first three months of the fiscal year: October, November, and December), a separate model is specified in Appendix B that instead relies on an instrumental variable in place of major airline hiring to further address remaining concerns of endogeneity. The results in that appendix are generally consistent with the results that follow.

Results

The logistic model output is shown in Table 3.5. Jumping right to the focus of this dissertation—the effect of major airline hires on attrition—it appears that an increase in major airline hires predicts an increase in pilot attrition across all aircraft types. It is noteworthy that the effect on all aircraft types, except CSAR, are significant at at least the 1 percent level for major airline hires. This makes sense because, in general, all pilots, except CSAR pilots, are eligible to fly for the major airlines. The fact that an increase in major airline hires still predicts an increase in pilot attrition for CSAR pilots may be the result of major airline hiring serving as a proxy for other jobs in the civilian world or even the health of the economy and jobs in areas that CSAR pilots are likely to pursue.

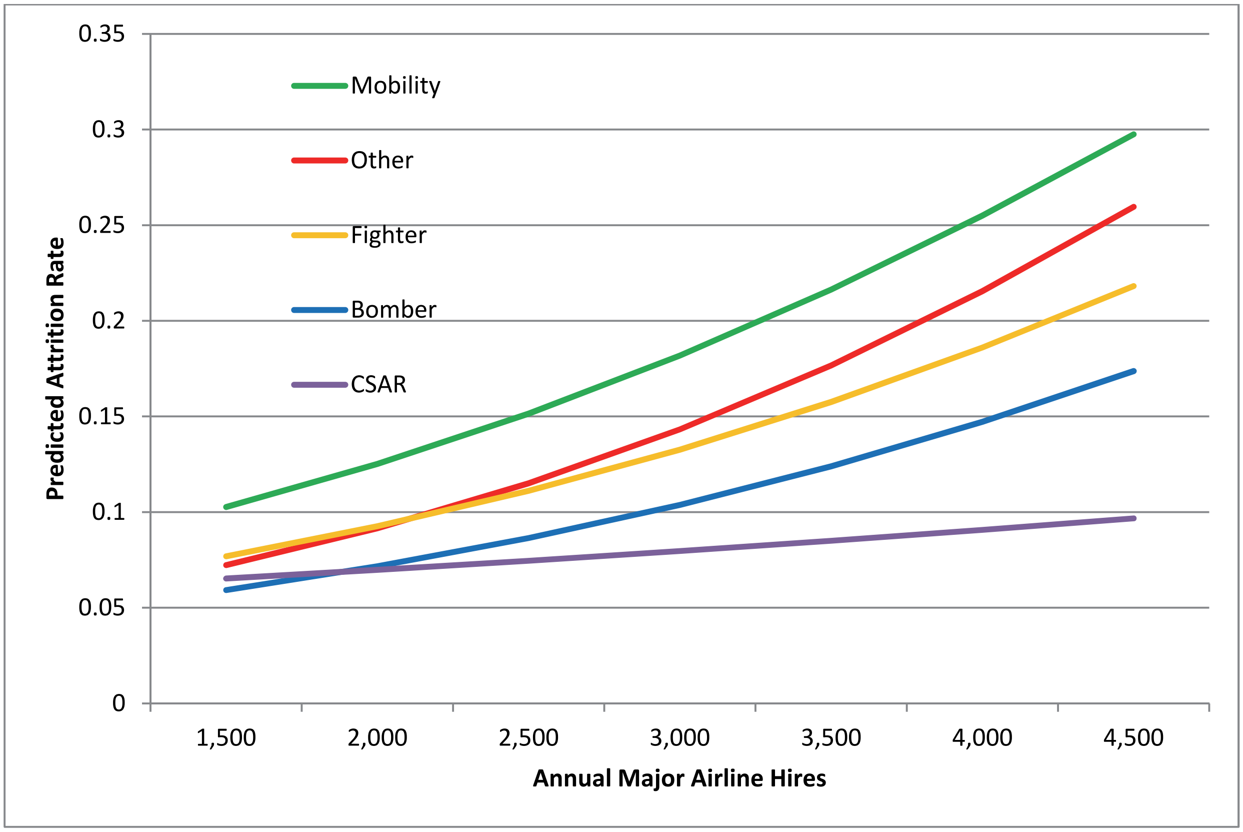
Table 3.5: Logistic Model Odds Ratios Output

Covariates		Fighter	Bomber	Mobility	CSAR	Other
ADSC Window	Year 1	1.366064**	1.385166	1.359441**	1.747051*	0.9937067
	Year 2	0.8492322	0.7094659	0.699221**	0.80447	0.4069353**
≥ 15 YOS		0.3505299*	0.4857827	0.2871276**	2.012995	1.867432
Female		1.789231*	1.984511	1.682942**	2.484788*	2.729927*
Not Married		1.355845**	1.271092	1.49656**	1.393786	2.294769**
Any Children		1.116304	0.8161942	1.249749**	1.653791	1.572902
Number of Children		0.9910839	0.986285	0.8521435**	0.7156968	0.916684
Non-White		1.086731	1.236944	1.242094**	1.091405	0.9739411
Commissioning Source	USAFA	0.7956993**	0.8030003	0.8279091**	0.987294	0.7887847
	OTS	1.238666*	1.392992	1.31563**	0.6713281	1.116526
YOS		0.9217599	0.9522984	0.8618035**	0.9829257	0.8987802
<10 YOS		0.7765235	0.7577497	0.7651206**	0.8832605	0.4338771*
Any Deployments		0.5551634**	0.6743618	0.9299242	0.5484925	0.4127418*
Number of Deployments		1.248656**	0.9601128	1.023509	1.251126	1.165718
Monthly ACIP (100s)		0.7868251**	0.7945604*	0.7881148**	0.6536916**	0.7713631**
Monthly Base Pay (100s)		0.9586199*	0.9482451	0.9436775**	0.8870903*	0.909541**
ACP PDV (10,000s)		0.8980569**	0.8998827*	0.9450871**	0.853962*	0.846347**
Over Flying Hours Threshold		1.48476**	1.994764**	2.287169**	1.161445	2.338246**
Combat Hours		0.9998359	0.999138	0.9991796**	0.9974281	0.9990596*
Out of Last 4 Years, How Many Did Pilot Log <75 1st Pilot Hours	1	1.416161**	0.9806921	1.214336**	1.158677	0.8980041
	2	1.744169**	0.7813235	1.422494**	1.039109	1.13175
	3	1.867538**	1.390007	1.646647**	0.7196042	1.972196*
	4	2.349632**	0.3565059	2.100219**	1.677841	2.268515
CPS Yearly Wage		1.074653	1.177412	1.194321**	1.441397**	1.053292
Major Airline Hires (1,000s)		1.513961**	1.386832**	1.604231**	1.166483	1.731351**
Monthly Major Airline Salary (1,000s)		1.157569**	1.174234	1.143094**	0.8109254	1.050755
Pseudo-R^2		0.0641	0.0996	0.1337	0.1103	0.1581

Notes: Odds ratios are reported. Model uses robust standard errors. Dependent variable=0 if pilot is present in active duty personnel file in the following year, =1 otherwise. All monetary values have been normalized to 1999 constant dollars. See text for definitions of variables. P-values have not been adjusted as there does not appear to be a multiple comparisons problem.
* Denotes significance at the 5 % level.
** Denotes significance at the 1% level.

As is apparent in Figure 3.14, mobility pilots in the years 1995–2011 have the highest levels of predicted attrition for all levels of major airline hiring witnessed in the period. “Other” pilots and fighter pilots are next, followed by bomber pilots and of course CSAR pilots. The important takeaway from this plot of marginal effects is that an increase in major airline hiring appears to increase active duty air force pilot attrition across all aircraft types flown.

Figure 3.14: Marginal Effects Plot on Major Airline Hires



It may be helpful to return now to the rest of the model and discuss the contribution of the covariates to an individual's likelihood of leaving active duty. As compared to year zero of an individual's ADSC window, individuals at year 1 in the window are more likely to leave (except for "Other" pilots, and this effect it not statistically significant), while those individuals who have made it to year 2 are less likely to leave. Fighter, bomber, and mobility pilots within five years of 20 YOS, and hence within five years of being eligible to retire from the military, are less likely to leave active duty. Being female, not married, or non-white tends to predict higher rates of attrition than being male, married, or white, respectively. While having children tends to predict that an individual is more likely to leave, once an individual has had children, having more of them tends to predict that the individual is less likely to leave for each additional child.

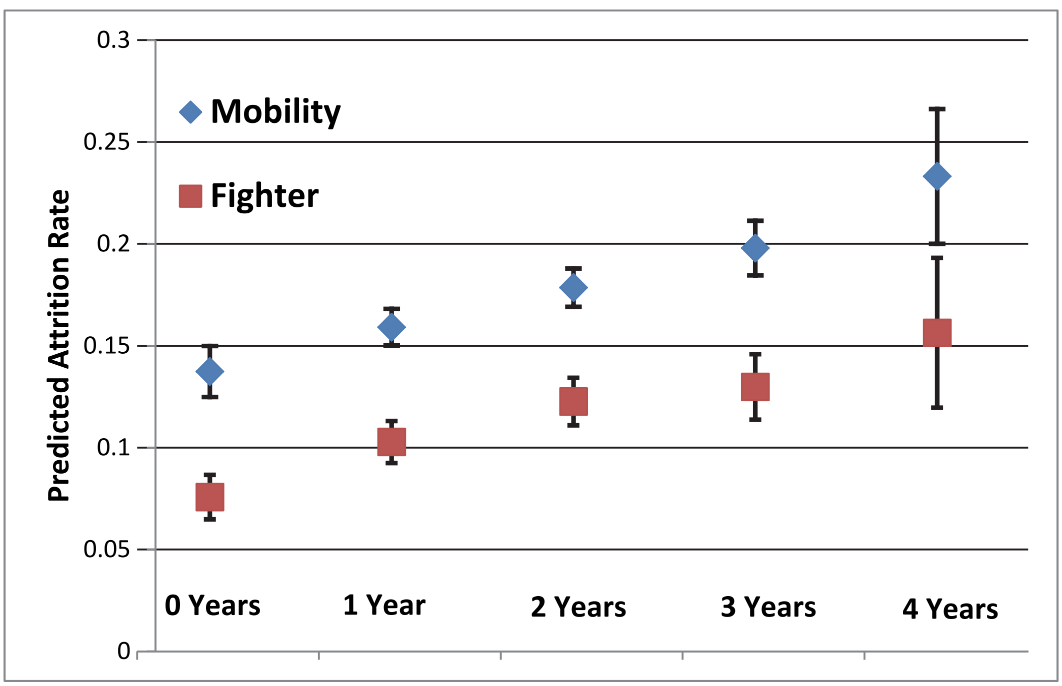
Compared with individuals commissioned in ROTC programs, USAFA graduates are less likely to leave active duty, and being commissioned another way predicts that the individual is more likely to leave active duty. Having any deployments tends to predict lower levels of attrition, but as the number of deployments increases so too does an individual's predicted probability of leaving active duty.

As expected, increases in any of the three military pay forms predict that an individual is less likely to leave active duty as a result. This brings up two main questions. First, since the population of pilots in the future will on average be at a higher pay grade (their ADSC term is on

average longer, meaning that their ADSC window will occur at a relatively higher pay grade), is the effect of basic pay appropriate to translate from the 1995–2011 population to the future population? Hopefully, by also controlling for YOS, it is appropriate, but this is definitely an area that future data can shed some light on. Second, since ACIP and ACP affect predicted attrition, can they be used in the future to affect attrition? I will assume yes, since I am assuming pilots are rational actors with preferences that transfer to the future population.

Pilots were more likely to leave the Air Force if they were over the flying hours threshold. Along this same vein of thought, it appears the predicted probability of leaving active duty is also influenced by the number of years an individual has fewer than 75 first pilot flying hours. Fighter pilots and mobility pilots were especially affected by years with less than 75 first pilot flying hours. Figure 3.15 shows the marginal effect—with 95 percent confidence intervals—each year number has on predicted attrition for fighter and mobility pilots. Statistically, fighter and mobility pilots are more likely to leave if they have experienced at least one year out of the past four years of flying less than 75 first pilot hours as compared with having experienced no years out of the past four years.

Figure 3.15: Mobility and Fighter Pilot 95 Percent Confidence Interval Marginal Effects Plot on First Pilot Nonflying YEARS

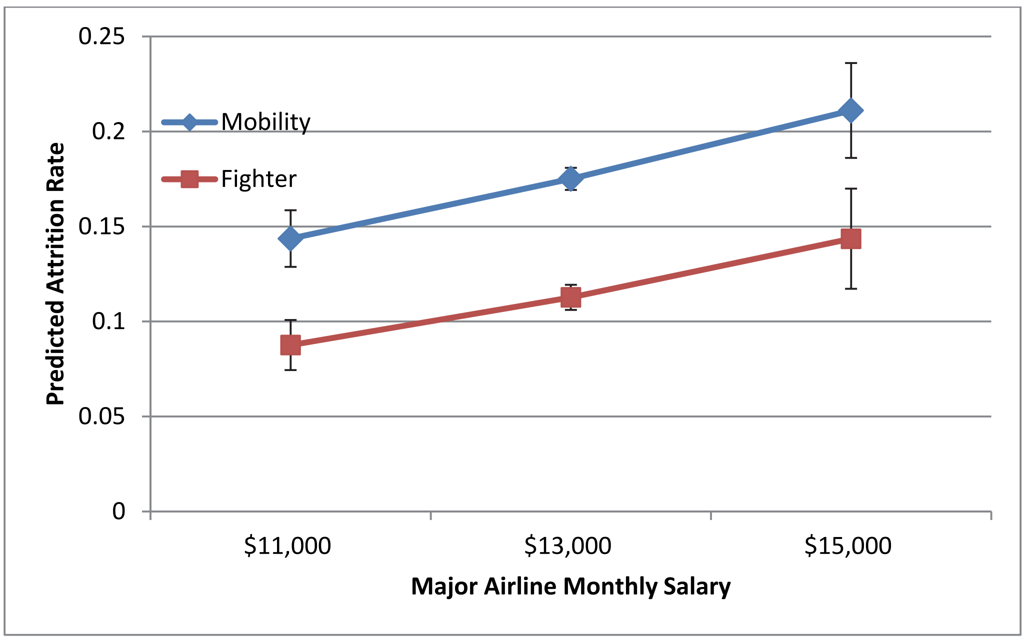


For example, interpreting the logit results in Table 3.5 vis-à-vis Figure 3.15 shows that a fighter pilot who logged less than 75 first pilot hours each of the past four years has about 2.35 the odds of leaving active duty compared with an individual who logged more than 75 first pilot hours each of the past four years. In essence, fewer opportunities to fly in the left seat (or only

seat) increase an individual's chances of leaving the active duty Air Force. This shows the importance of not only maintaining flying hours for a pilot's proficiency, but potentially also for their morale. If a pilot finds his or her opportunities to fly in the active duty Air Force being cut, he or she might look elsewhere for opportunities, or at the very least, be more willing to leave active duty.

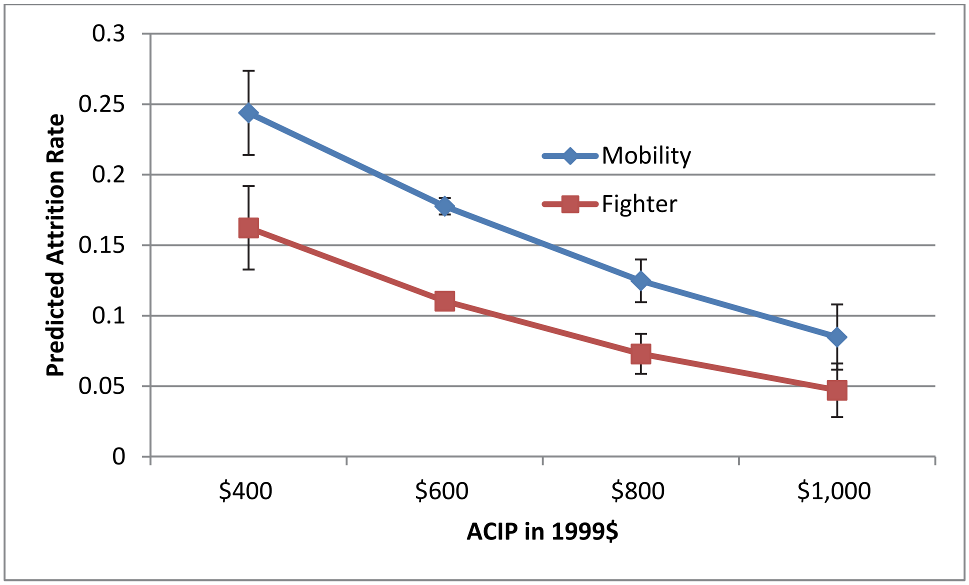
It appears that the value of a major airline salary also impacts a pilot's decision (Figure 3.16). As the monthly value of major airline senior captains with greater than 12 years on the job increased, the predicted probability of attrition increased.

Figure 3.16: Mobility and Fighter Pilot 95 Percent Confidence Interval Marginal Effects Plot on Major Airline Monthly Salary for Senior Captain with Greater than 12 YOS



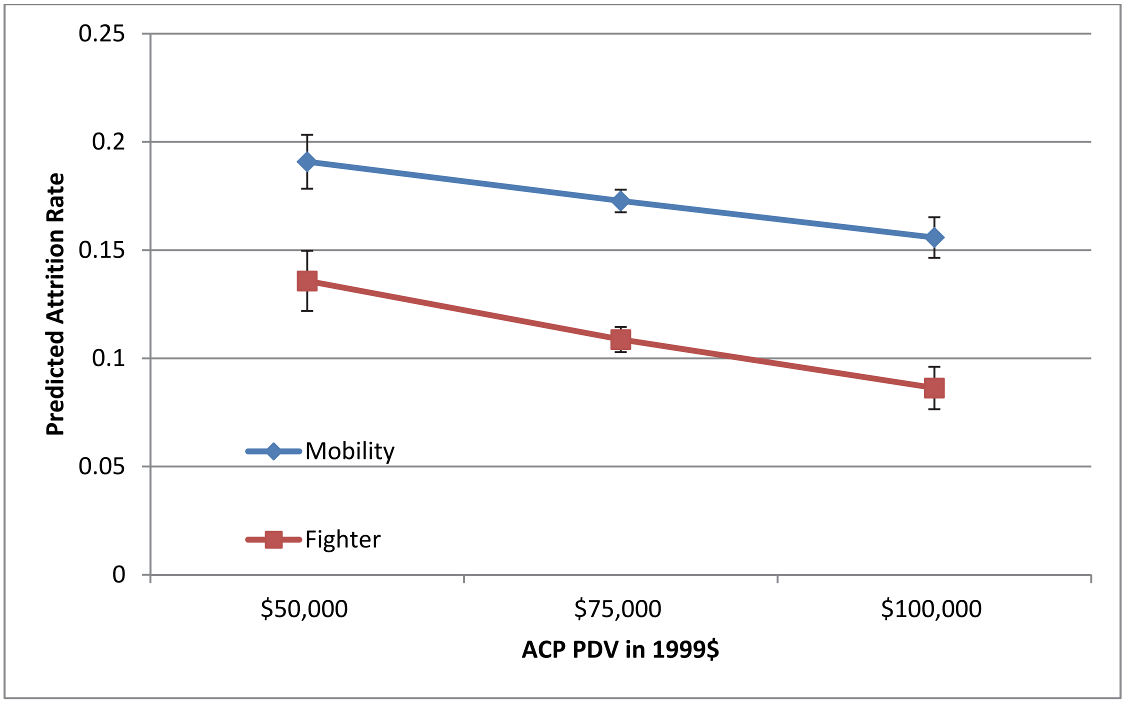
But changes in military pay also had an impact on a pilot's decision (Figure 3.17). For instance, varying the value of the monthly ACIP decreased a pilot's probability of getting out. The nominal value of the ACIP for aviators with 6–13 YAS has not been updated since 1987. While in 1987, $650 was worth almost $1,000 dollars in 1999 terms, the value has eroded to a 1999 value of about $460 in 2014. This is potentially an area where either restoring some of the real value, or even indexing for inflation in the future, may help decrease attrition.

Figure 3.17: Mobility and Fighter Pilot 95 Percent Confidence Interval Marginal Effects Plot on Monthly ACIP Value



Similarly, increasing the PDV of the ACP being offered also predicts a marginal effect of decreased attrition (Figure 3.18). However, in terms of the total effect on attrition, the ranges of ACIP values being used appear to have a higher marginal impact on attrition rates than do the range of ACP values being used.

Figure 3.18: Mobility and Fighter Pilot 95 Percent Confidence Interval Marginal Effects Plot on ACP PDV

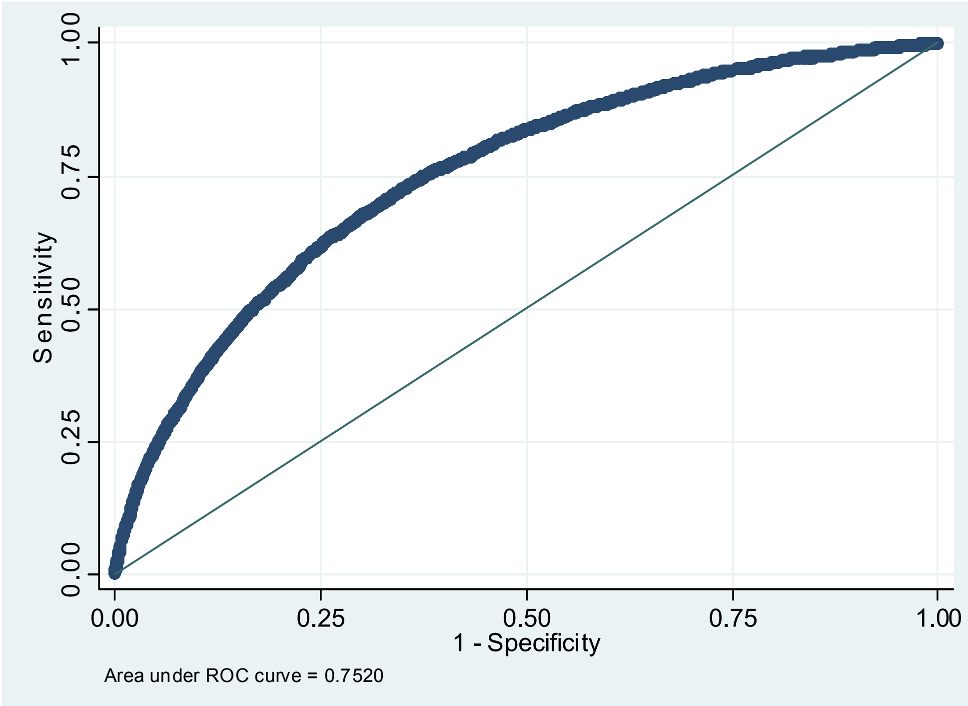


Model Cross-Validation

The model chosen also has lower levels of prediction error compared with other specifications. Prediction error is a measurement of how well the model predicts the outcome for new observations not used in generating the prediction model. While larger models (those including many covariates) often help account for much of the variance in attrition, they may be overfitted to the data. That is, they may be too closely fitted to the idiosyncrasies of the data. Then, when the larger model is applied to other data, it does a poor job.

For model validation, ten simulations of a ten-fold cross-validation were used to test for prediction error. The dataset was randomly divided into ten mutually exclusive subsets of equal size. Each subset was ignored while the model was estimated using the nine remaining subsets. Then the parameter estimates from the model were used to calculate the predicted attrition of the set-aside subset. This in turn reveals the prediction error for that *fold*. This is repeated for the remaining nine subsets, and then the whole process is repeated nine more times using new partitions of the data each time. The metric used to measure prediction error is the area under the Receiver Operating Characteristic (ROC)–curve. The naïve estimate, in which the fitted probabilities from the entire dataset are plotted and tested in the ability to discriminate between attrition and retention, is plotted in Figure 3.19.

Figure 3.19: Initial ROC-Curve

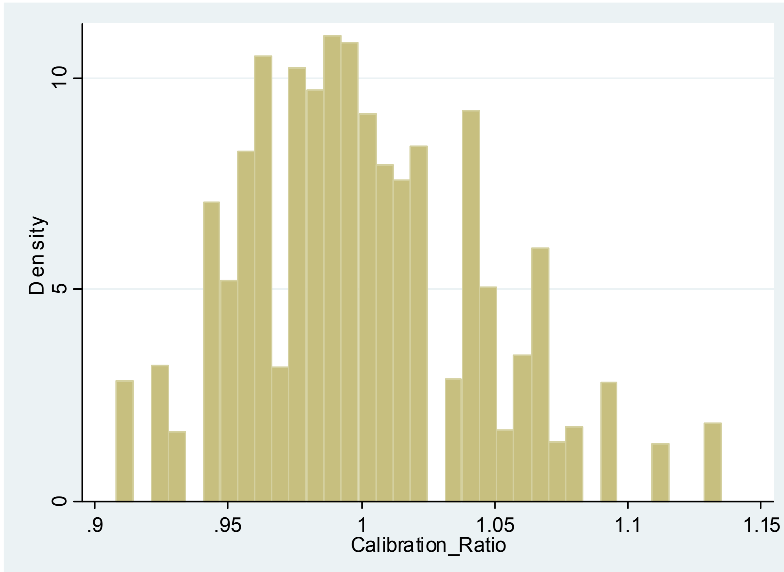


$Sensitivity$ refers to the model's ability to accurately predict attrition when the pilot in fact did leave. The bottom axis, $1 - Specificity$, reveals the model's ability to accurately predict retention when the pilot did not leave. The area under the curve (AUC) is then a measurement of the model's ability to discriminate between the two events. The naïve estimate of 0.7520 shows that the model does a fair job at discriminating between retention and attrition. A worthless model would have an AUC of 0.5, while a perfect model would have an AUC of 1. In general, an AUC between 0.7 and 0.8 is considered fair. The cross-validated estimate of 0.7519913 confirms the belief that the model is not overfitted in predicting attrition. The AUC is simply telling us that if we had a representative sample of two pilots in any given year where one pilot was getting out and one pilot was staying in, and we picked one of the pilots at random, the model would correctly predict their outcome about 75 percent of the time.

Model Calibration

As with any model, one needs to ensure the model is calibrated such that it doesn't overpredict or underpredict the outcome. In doing this, I took advantage of the cross-validation technique to simultaneously compute calibration ratios during each fold and simulation. The 100 calibration ratios are spread between 0.9 and 1.1, with the bulk being closer to 1. A ratio of less than 1 means the model underpredicts attrition, whereas a ratio of greater than 1 means the model overpredicts attrition.

Figure 3.20: Calibration Ratios Histogram



In sum, the final model relied upon for analysis appears to be calibrated nicely and does not appear to be overfitted to the data from 1995 to 2011. This will become all the more important as the model is used in the next chapter to predict future attrition. Additionally, the model appears to strike a healthy balance between the theoretically robust model and one that is pragmatic and simple enough to be applied to future years without having to go out on a limb projecting future values of more arcane covariates.

Conclusion

Major airline hires do have a strong effect on pilot attrition. For example, an increase in yearly major airline hires of 1,000 is predicted to increase a fighter pilot's odds of leaving active duty by about 50 percent. In real terms, let's say this individual pegged their own chances of leaving active duty at 33 percent given the present level of airline hiring. This means the odds of leaving to staying are 1:2. All of a sudden, airline hires picked up by 1,000 that year. This theoretical person would update their odds to 3:4, and their probability of leaving active duty is now over 40 percent. Mobility and other pilots experienced even larger marginal effects than fighter pilots. When this scenario plays out with a couple thousand eligible pilots each year, suddenly any increase in airline hires will be registered by a significant increase in pilots exiting active duty.

While the Air Force may have a hard time using some pilot characteristics, such as marital status and commissioning source, to influence a pilot's odds of leaving active duty, the model above does identify other levers the Air Force can maneuver that may have some influence on the pilot's decision. The Air Force is often criticized for simply "throwing money" at the retention issue. But, it appears that both the amount of money and the manner in which the

money is “thrown” have an impact on the pilot’s decision. The Air Force would not be simply throwing away the money if it relied on the fact that pilots are rational actors, and therefore offered monetary incentives that are cost-effective in terms of the costs retained that otherwise would have been lost (due to the difference in pilot attrition).

The next chapter will revisit this discussion, but it may be worth re-evaluating ACIP and ACP as retention mechanisms. Restructuring the incentive or continuation pays, or changing their value, gives the Air Force another tool for retention management. Additionally, pilots have devoted years of energy and effort to get behind the yolks of the Air Force’s fleet. Ensuring that they can continue to log hours in control of those aircraft may help keep the pilots happy and therefore more inclined to stay in the active duty corps.

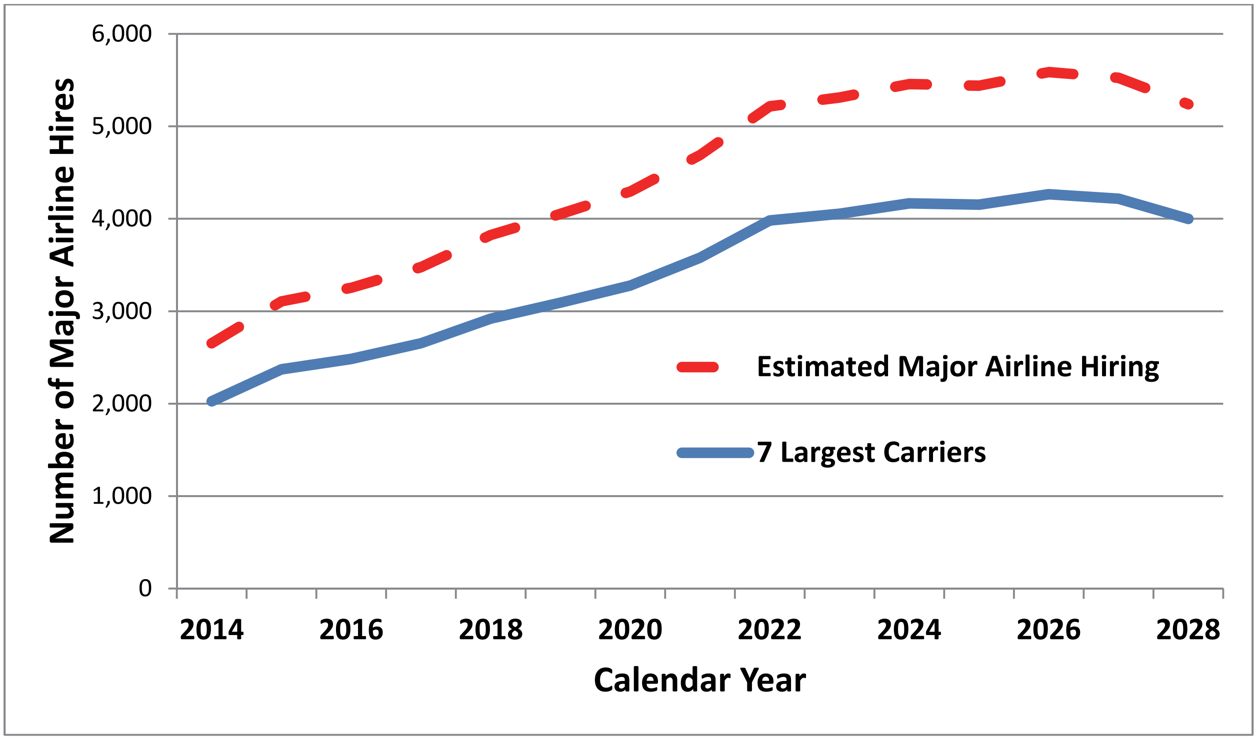
Chapter Four: Predictions

Overview

This chapter builds off the previous chapter's results to predict what active duty Air Force pilot attrition might look like over the next six years. Specifically, this chapter uses the results generated from the logistic model to assign a predicted probability of attrition to pilots whose ADSC windows occur in the next six years. While the following paragraphs will delve deeper into the ins and outs of projecting pilots and covariates into the future, it is worth mentioning that major airline hiring is expected to increase each year for the next decade.

We can project future major airline pilot hiring using estimates on the seven largest U.S. Carriers (taken from FAPA.aero). These carriers accounted for about three-quarters of all major airline hires in the years 1990–2012. Future total major airline hiring is then normalized from these carriers' estimates (Figure 4.1). If the stock of eligible pilots in the future is anything like the pilots reaching the end of their initial ADSC in the past decade-and-a-half, then it is expected that the estimated increase in future major airline hiring will tend to predict an increase in future active duty Air Force pilot attrition.

Figure 4.1: Future Estimated Major Airline Pilot Hiring



Source: FAPA.aero.
Note: These seven largest U.S. air carriers (Alaska, American Airlines and US Airways, Delta and Northwest, FedEx, Southwest and AirTran, United and Continental, UPS) accounted for 76% of major airline hires in years 1990–2012. Total estimate is derived from these seven carriers' totals.

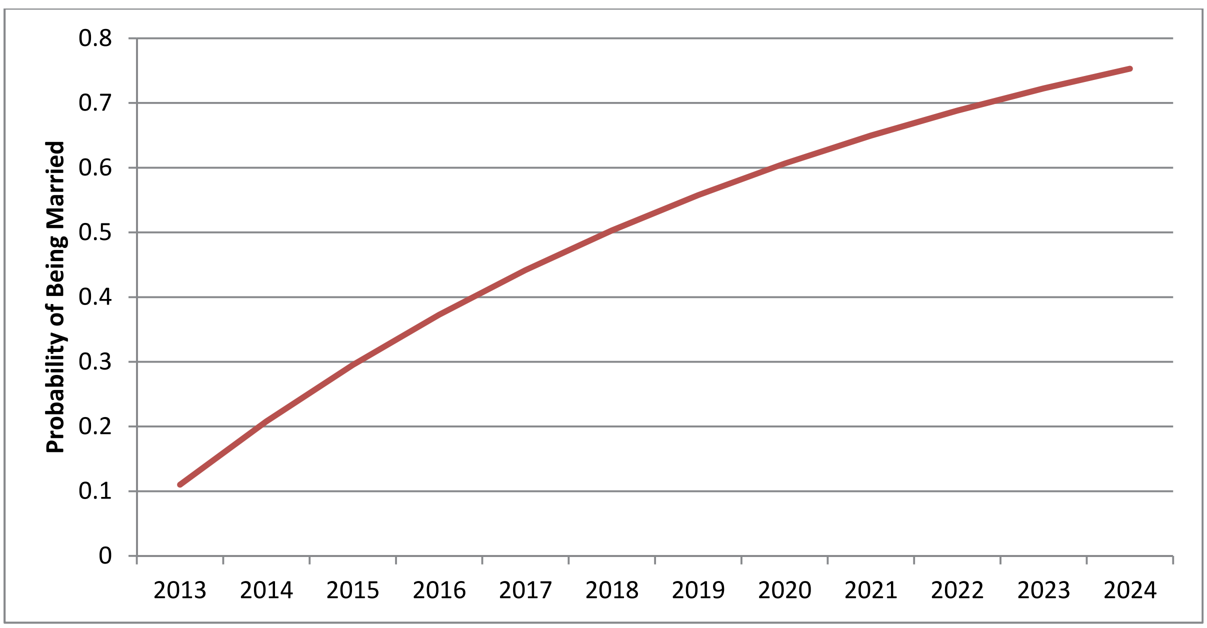
Projecting

The projections in this chapter rely on pilots present in AFPC personnel files at the end of fiscal year 2012. The model projects each pilot forward into their ADSC window, and is really concerned only with pilots whose ADSC windows occur from 2012 to 2019. As a reminder, a prediction run on one fiscal year yields the attrition profile for the next fiscal year, since the model is predicting the probability of leaving sometime before the end of the next fiscal year. Thus, this model yields attrition profiles for years 2013–2020. While the model is generating results for the years 2013 and 2014—and thus reshaping which pilots will be available in subsequent years—the results will report the profiles only for years 2015–2020. Additionally, I do have enough data to predict profiles for the years 2021–2023. Since the landscape and policies affecting attrition and the inventory of pilots will almost certainly change in the next few years, predictions further into the future are more precariously uncertain, and models are not capable of capturing this uncertainty. Therefore, 2020 appears a good threshold at which to cap the predictions. It is far enough out to give one the sense of what future attrition might look like given the anticipated increase in major airline hires, but not so far that uncertainty can greatly overwhelm one's confidence in the future predictions.

In projecting pilots into the future, the covariates can be divided into two categories. The first category, those covariates that do not change, is the easier of the two to deal with. For example, an individual's cohort-year—year of graduating pilot training—does not change. Thus, a pilot's ADSC window and YOS are easy to project. Likewise, I can also assume that an individual's commissioning source, gender, and ethnicity will not change. From here, however, the remaining covariates require some investigation and assumptions to project forward, since they do depend on time and therefore are expected to change during the course of the projection.

First, looking at the data from 1995 to 2011, it appears that a pilot who is single in one year has about an 11 percent chance of being married the next year. While many confounding characteristics were explored for their effect on the probability of getting married, this 11 percent rate did not appear to be statistically different across many characteristics, and in general appears in line with Centers for Disease Control and Prevention estimates for marriage probabilities at certain ages. This binomial probability prompted the creation of a cumulative distribution function yielding the probability of being married at any given year beyond 2012 for individuals who were single in 2012 (Figure 4.2).

Figure 4.2: Probability of Being Married in Future Years, Given Single in FY2012



By 2018, over half of the individuals who were single in 2012 are projected to be married. I assumed that once a pilot gets married, he or she stays married. Thus, any individuals already listed as married in 2012 retain their marital status into the future.

I then estimated the number of children a pilot has in the future. Unlike marital status, the number of children an individual may have in any given year is memory-less. That is, the number is stochastically determined independent of how many children the individual had the

previous year. I assumed that only married individuals have children, and I used the proportions of children numbers among married pilots from 1995 to 2012 to determine children number proportions in the future (Table 2.4).

Table 4.1: Probability of Married Pilot Having Number of Children Any Given Year

Number of Children	Probability of Married Pilot Having Number of Children Any Given Year
0	38.90%
1	22.17%
2	26.65%
3	9.39%
4	2.31%
5	0.40%
6	0.12%
7	0.04%
8	0.02%

This then determined whether or not an individual has any children at all (another covariate used in the model). To sum up the process for determining an individual's family characteristics:

- Married pilots in 2012 remain married in future projections.
- Single pilots have an 11 percent chance of getting married from one year to the next.
- If a pilot is married, he or she is eligible in the model to have children.
- The number of children is assigned (and can change for each pilot each year) based on the proportions witnessed in married pilots for 1995–2012.

This information is then used to determine the covariate indicating whether or not an individual has children.

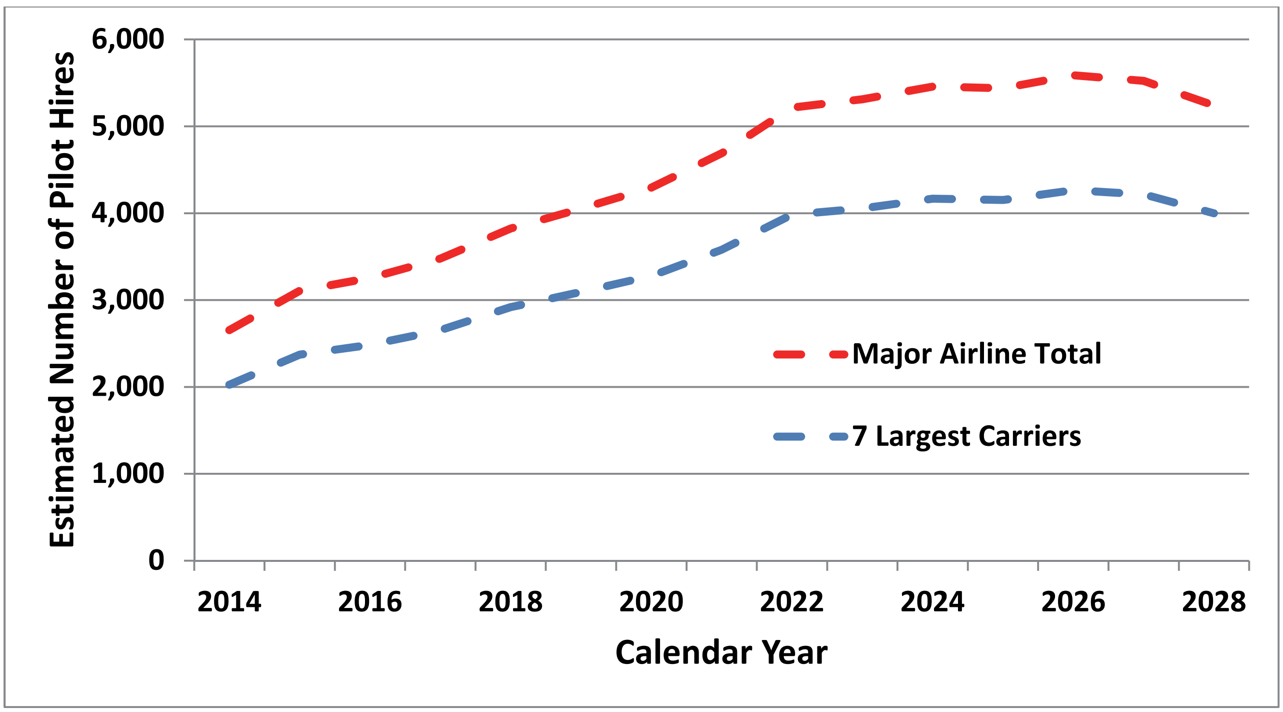
Next, I determined deployment numbers using the distribution of deployment numbers for eligible pilots in their ADSC windows in 1995–2011. Projecting deployment numbers proved one of the most challenging portions of the projection, and this remains an area where future research and analysis could provide a better projection. I explored a number of different techniques, including matching deployment distributions by YOS, ADSC window, aircraft most recently flown, and looking at how the deployment distributions changed over the years. Although I had no way of formally checking, it seems likely that the deployment data received are incomplete, since in any given year only about a quarter of all eligible pilots had ever been on a deployment. But once a pilot had been on a deployment, it was more likely that he or she had been on more than one deployment. This suggests that deployment data are missing for many pilots.

The inclusion of the deployment data does seem to help stabilize the results in the model. Additionally, the pilots who have had deployments do not appear to be a statistically different

subset—vis-à-vis all other covariate measures—of the total population, or as compared with those pilots who did not have any deployments. Lastly, as a guard against any potential bias the inclusion of deployments may cause, I included an indicator variable indicating whether or not a pilot had ever been deployed in addition to a variable measuring the number of times a pilot was deployed. Still, deployments remain an area where updated data might provide more accurate results and projections.

Next, I projected the number of yearly major airline hires using estimates from FAPA.aero's projected number of hires for the seven largest U.S. air carriers (Figure 4.3). These carriers accounted for 76 percent of total major airline hires in the years 1990–2012. I assumed these carriers represent 76 percent of each future year's total major airline hires, and I normalized the estimates to achieve a 100 percent future major airline hiring estimate.

Figure 4.3: Future Estimated Major Airline Pilot Hiring



I focused on the years 2014–2019. Major airline hires are estimated to rise monotonically from around 2,650 hires in 2014 to more than 4,000 in 2019. While this estimated increase is impressive, it pales in comparison to the increase in hiring that occurred when major airline hiring increased from 547 in 1993 to 5,105 in 2000.

Next, I used these major airline hiring estimates to in turn estimate both the average annual pilot CPS wage and the major airline monthly salary for a senior captain with more than 12 YOS. This is another area where future work may yield better estimates for these covariates. Currently, I am just using a simple linear regression to estimate the effect of major airline hiring on each of

those covariates over the years 1995–2011. For both covariate future estimates, I achieved R^2's of only about 0.06.[16] Future work may take into account other measures, such as GDP (and then projected GDP). On the whole, both are expected to rise with rising hiring. There is a lot of uncertainty not only in predicting major airline hires but also in predicting pilot wages/salaries. Much of this has to do with the changing landscape of how civilian pilots progress to become major airline pilots. A new regulation goes into effect that significantly changes the minimum flying hours from 250 to 1,500 for all airline pilots (including first officers and regional commercial pilots) (Kaufman, 2012). This may constrict the number of pilots eligible to become hired, which may change wages and salaries in unforeseen ways.

Projecting military pay was one of the more relatively straightforward portions. First, I used existing military pay charts for the data in years 2012–2014. No estimates were required here. Second, for base pay I matched individuals by YOS and assumed pay increases would match inflation. More specifically, I assumed that individuals with 10–13 YOS would be majors and individuals with 14–19 YOS would be lieutenant colonels. Then I used the 2014 military pay chart (indexed to 1999 constant dollars) to provide their expected base pay. By assuming pay increases would match inflation, the 2014 chart was used to provide the constant dollar values for all future years.

In projecting the ACIP, I let the current $650 nominal value for pilots with 6–13 YAS become the status quo. I then assumed an inflation rate of 2.5 percent for each year after 2014, meaning the ACIP decreases in real value 2.5 percent each future year. I also included an option where the ACIP would be indexed to inflation, and would thus have a non-eroding real value of about $464 (in 1999 constant dollars) for each year. This option is for exploring policy recommendations.

My ACP projections also include different options for exploring policy recommendations. All ACP options used assumed a five-year additional commitment, and thus a five-year payout period. On top of the $25,000, $30,000, $35,000, and $40,000 per year offerings, I also explored using 50 percent up-front lump-sum options. For example, if a person has the option of selecting a 50 percent lump-sum of the $25,000 a year offering, they would receive half of the total in the first year ($62,500), and then the remaining would be divided up equally in the four remaining years. I assumed that pilots have a 10 percent discount rate and that inflation is 2.5 percent a year. These two assumptions greatly differentiate the lump-sum and regular option real values. For example, in 2015 the real value (in 1999 constant dollars) of the regular five-year $25,000 per year ACP is $55,224. The 50 percent lump-sum option increases the real value of the ACP to$72,945. Having the different options available helps clearly show the effect the different ACP options have on attrition.

Since the projection uses data on pilots present in FY2012, it does not fully capture which aircrafts certain cohort-years will be flying by the time they are in their ADSC windows. Many

[16] Small though the R^2 value is, the resulting estimates were all within the bounds of previous real values.

of the pilots being projected are in upgrade aircraft (various types of training aircraft), and still for others their Rated Distribution and Management (RDTM) codes are blank. Since the individuals' RDTM codes are used to classify which type of aircraft they will be flying, I had to randomly assign RDTM codes to fit the distributions outlined in Air Force inventory production histories.[17] I assumed that pilots with trainer RDTM codes would become fighter pilots, and then I randomly distributed the remaining pilots RDTM blanks to achieve that year's inventory production distribution.

The type and amount of flying hours an individual accumulates depends heavily on the type of aircraft he or she flies. In determining total combat hours for CSAR pilots, I used the average total combat hours flown for individuals in their ADSC window since 2005. For all other aircraft types, I used the average from 2012. I used 1995–2011 to determine the distribution per aircraft type of the number of times an individual flew less than 75 first pilot hours in the past four fiscal years. Then I randomly assigned pilots in the projection a number (0–4) based on the prior probabilities. In determining whether individuals were above the total career flying hours threshold, I used an individual's aircraft type and YAS in randomly matching the distributions from 1995 to 2011.

After all the covariates have been projected forward from 2012, it is finally time for the main attrition attraction. The model is run separately on each aircraft type. After using the historical data to generate covariate estimates, the model is run on the future years to yield a predicted probability of attrition for each pilot-year observation. Since the decision is stochastic each year, the predicted probability is compared with a random number to then determine whether or not the pilot will leave active duty.[18] If they leave, they are no longer in the sample for subsequent years. Doing this on years 2014–2019 produces the attrition profiles for 2015–2020. This also allows us to evaluate the effect of different scenarios and policies (i.e., changing ACP and ACIP).

Results

As expected, the average annual predicted probability of attrition increases as the estimated number of major airline hires increases. The expected attrition rate is above the average attrition rate witnessed from 2002–2012, supporting the assertion that the attrition rate is predicted to increase into the future. Moreover, by the end of the decade, the attrition rate will be at a statistically significant—at the 0.05 α-level—higher average attrition rate than achieved in the years 2002–2012. The next question, of course, to ask is how this translates to actual numbers of

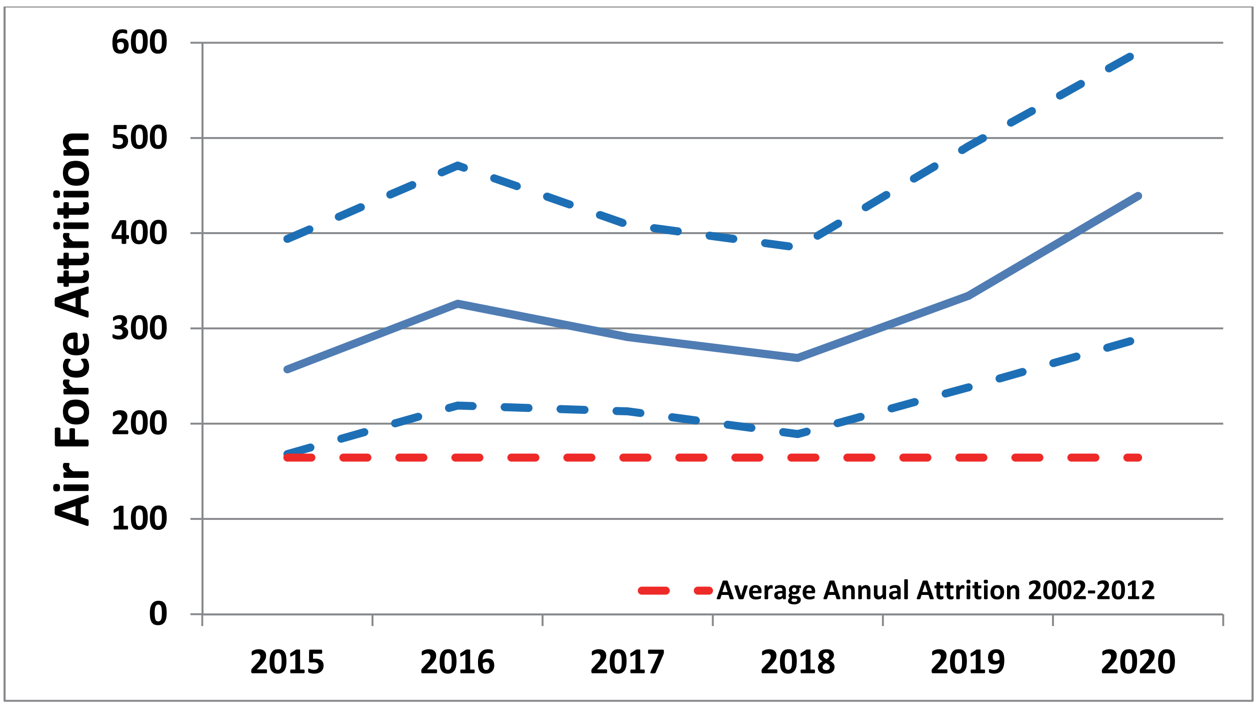
[17] Using CF-255 from the Air Force's Manpower Execution System for requirements, and using CF-175/507 from the Air Force's Military Personnel Data System (MilPDS) for inventories.

[18] In subsequent sensitivity analyses, this comparison was tested to see how much outcome variance to which it contributed. I ran 100 simulations and the results never deviated more than 3 pilots a year. The predictions all report the mode simulation, which happens to be the median numbers for all years 2015–2020. Additionally, each aircraft community never had the results deviate by more than 2 pilots a year.

pilots, especially since the past few years had fewer pilots eligible to leave active duty as the Air Force transitioned to the ten-year ADSC. An attrition rate confidence interval of a few percentage points can translate to an interval of a few hundred pilots when applied to the few thousand eligible pilots.

In looking at the predicted numbers of attrition, the comparison to recent attrition levels becomes even more pronounced, as each year is predicted to have a statistically significant higher number of pilots exiting active duty within their ADSC window. However, as shown in Figure 4.4, even though the predicted attrition rate increases in 2017 and 2018, the predicted number of pilots leaving decreases in those years due to there being fewer eligible pilots. But by 2020, the annual attrition number is predicted to be between 289 and 590 pilots, a large increase over recent attrition numbers.

Figure 4.4: Predicted Future Air Force Pilot Attrition with 95% Confidence Bounds

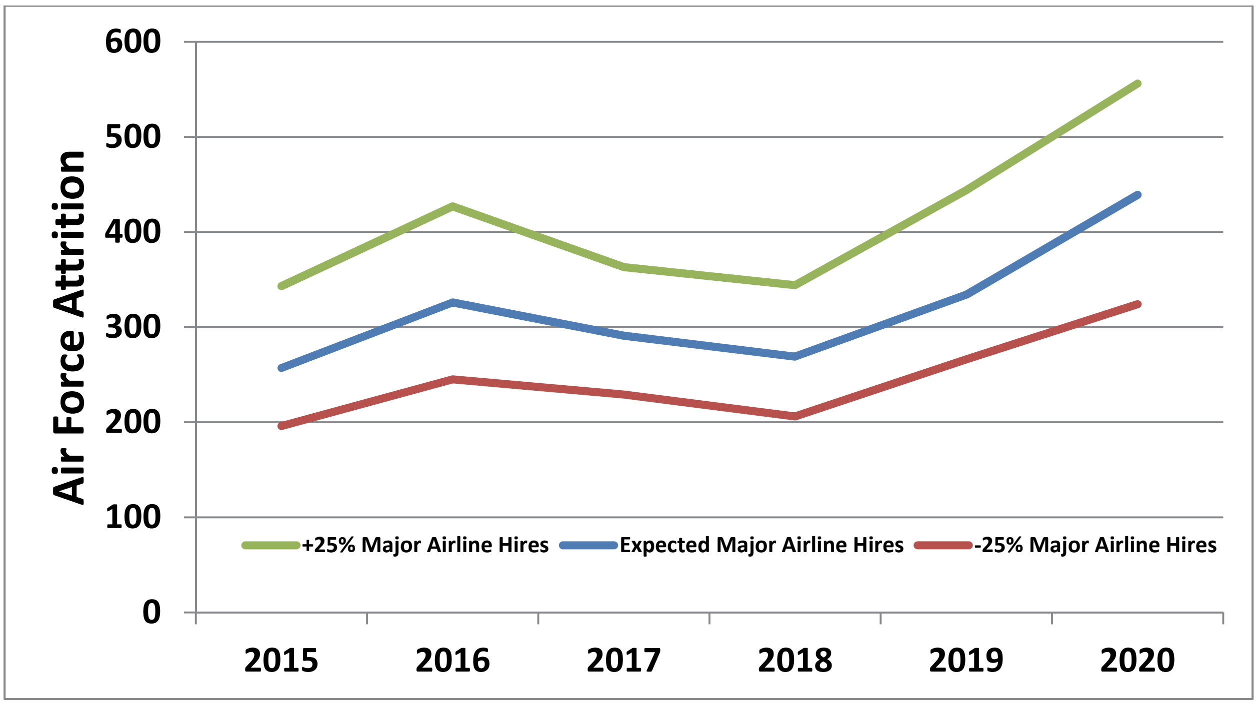


Note: Rates are adjusted to account for individuals leaving the Air Force, and thus no longer being part of the sample in subsequent years.

Since much of the variation in attrition is attributable to variation in major airline hiring, it is helpful to explore just how sensitive predicted attrition is to changes in major airline hiring, especially since estimating major airline hiring is also an imperfect estimation and estimates can change practically overnight—as was the case on 9/11 when a major airline hiring spree without an apparent end in sight was suddenly halted for years to come. Different regulations, geopolitical events, industry costs, or even changes in public perception, among yet even more factors, can all drastically impact the airlines and thus major airline hiring.

In modeling the effects of changing the number of major airline hires, there are two things to note. First, linearly changing the number of major airline hires does not have a simple linear effect on the outcome. That is, multiplying the number of hires by X does not then multiply the number of pilots leaving by X. The effect is nonlinear. However, the direction of the effect is as expected. Second, this scenario shows how subsequent-year attrition is somewhat dependent on previous-year attrition. For example, increasing major airline hiring by 25 percent greatly increases the attrition number in 2016 as compared with the base case (Figure 4.5). However, the number of pilots leaving in 2017 is proportionately fewer for the increased hiring scenario than the base case scenario, since the large increase in pilots leaving the previous year means there are fewer pilots left in the sample to leave in 2017. This adds to the notion that the effects of changing major airline hiring are not only nonlinear, they are also dynamic year-to-year.

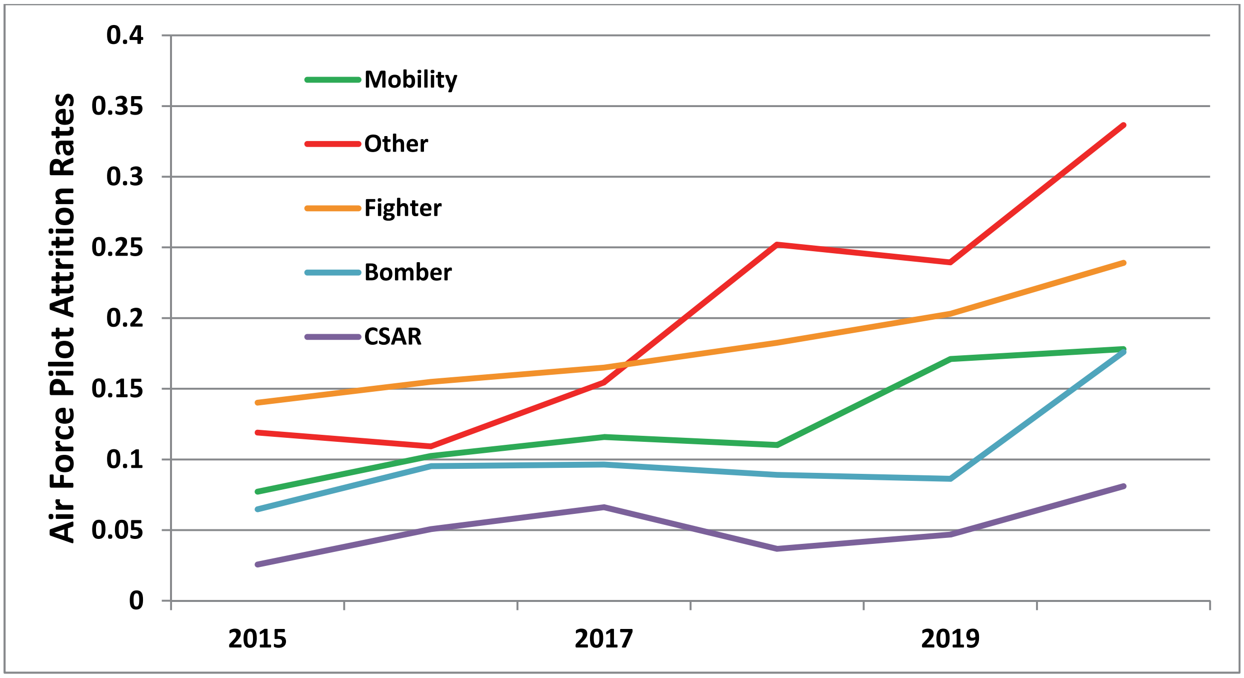
Figure 4.5: Predicted Future Air Force Pilot Attrition Using Projected Major Airline Hires ± 25%



The future predicted attrition rates all seem to make sense, except for the fact that the predicted fighter attrition rate is higher than the mobility attrition rate (Figure 4.6). After some exploration, it appears that this is due to the fact that mobility pilots are more sensitive to changes in base pay. Even after controlling for YOS, this base pay sensitivity has the effect of lowering future mobility attrition rates, since the population of pilots in the future will, on average, be earning higher base pay since they will, on average, be at a higher pay grade (due to increased ADSC lengths). This is a particular area where future research will benefit by drawing model estimates from mobility pilots at similar YOS in predicting future attrition. Lastly, Figure

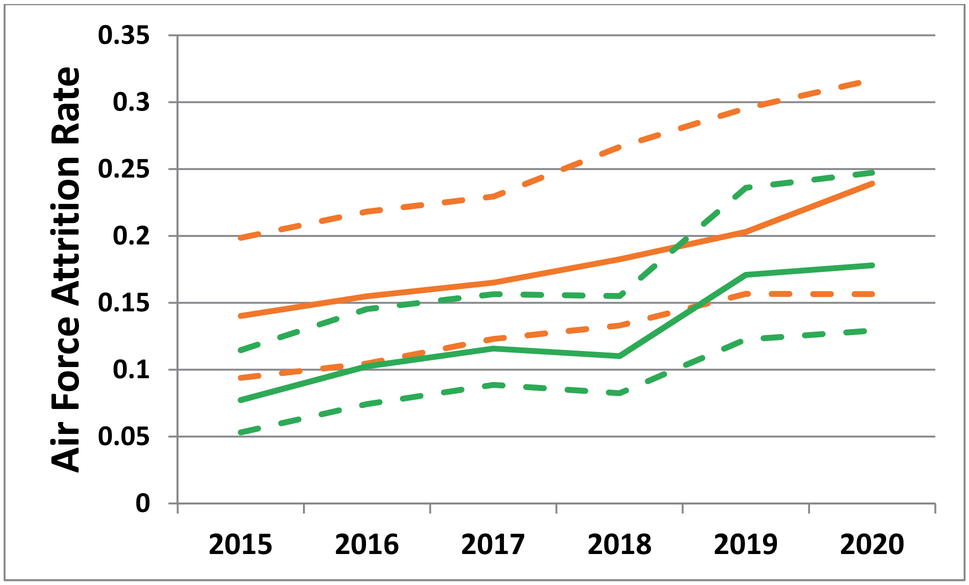
4.6 reiterates how much more sensitive pilots in the “Other” category are to changes in major airline hiring.

Figure 4.6: Predicted Future Air Force Pilot Attrition Rates, by Aircraft Community



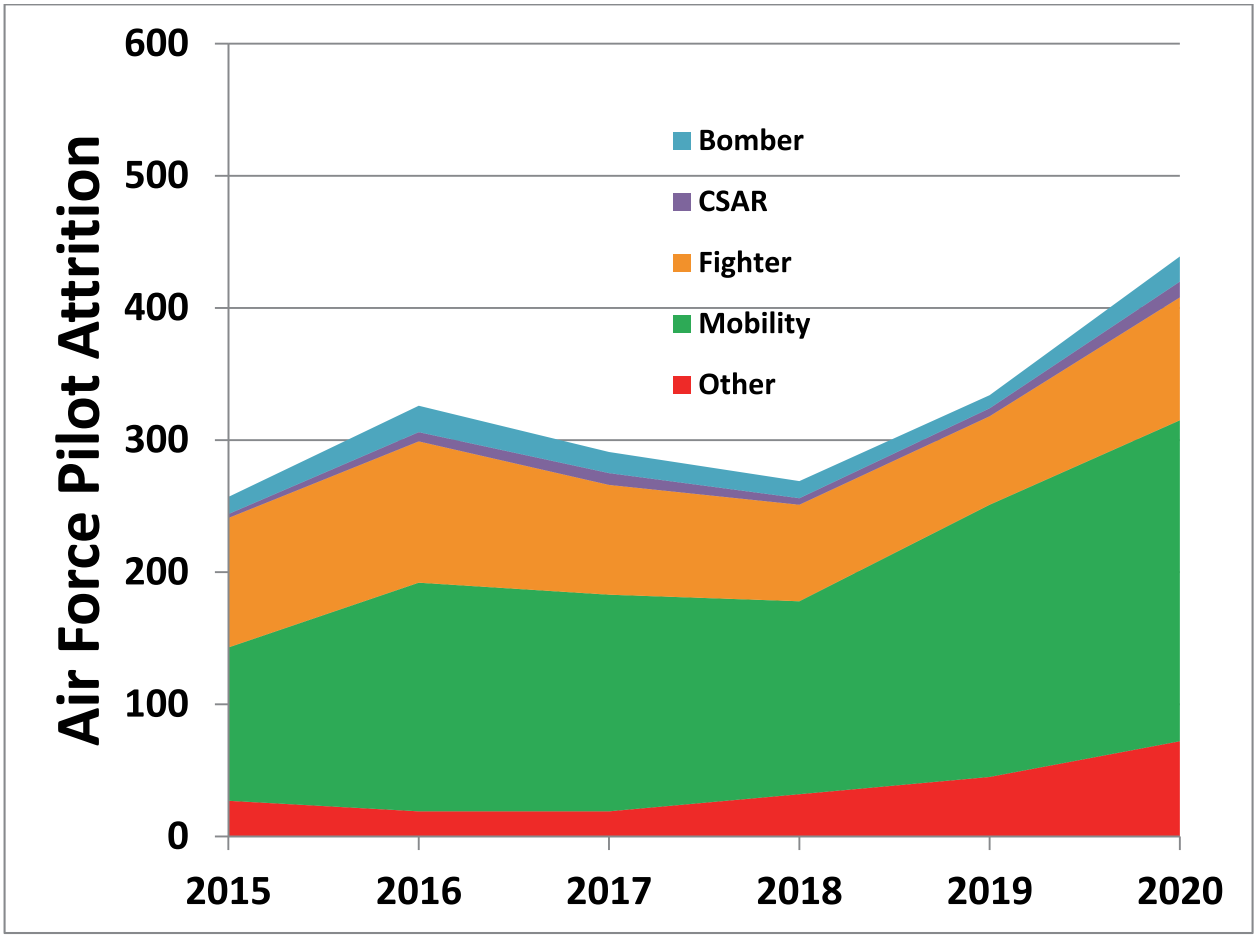
The difference between fighter and mobility pilots’ attrition rates are not statistically significant in any year (Figure 4.7). Thus, an outcome whereby mobility pilots experience higher attrition rates than fighter pilots is not wholly unexpected. Regardless, using the expected attrition rates, we can generate the future attrition profiles by type of aircraft flown.

Figure 4.7: Predicted Future Air Force Pilot Attrition Rates for Fighter and Mobility Communities with 95% Confidence Bounds



Just as in previous years, mobility and fighter pilots continue to make up the lion's share of attrition numbers (Figure 4.8). Much of the decrease in attrition numbers in 2018 is due to the decrease in mobility attrition numbers that year. Pilots in the "Other" category not only begin to make up a larger share of total attritions from 2018 to 2020, their attrition rate may also be problematic to some communities in the category (C2ISREW and SOF fixed-wing, to name a few). This warrants future research to investigate separating this category into smaller components on order to look at larger trends and surplus or shortage indicators. This is especially relevant given the category's high sensitivity—relative to other communities—to major airline hiring. Currently, however, the focus is on mobility and fighter pilots. Mobility pilots are in the midst of a large surplus, and fighter pilots are in the midst of a continuing shortage. While it is outside the scope of this dissertation to address all pilots in those communities, we can at least show some comparisons from what is happening to pilots inside their ADSC window to all pilots on active duty.

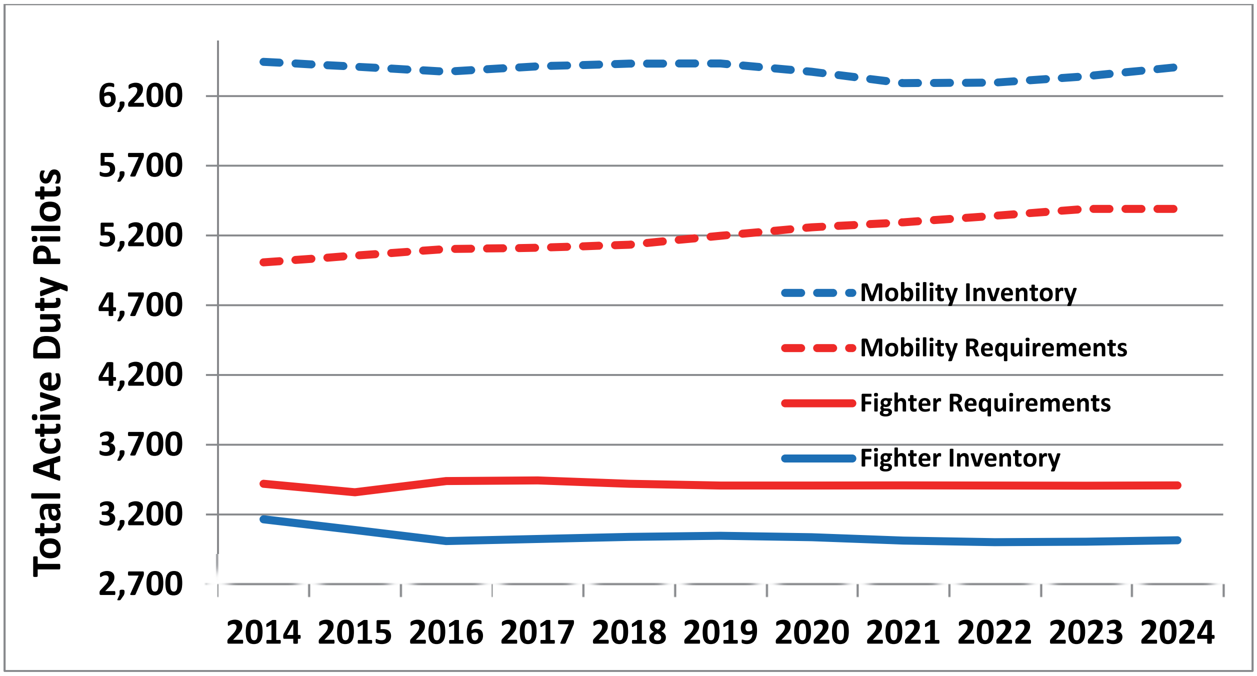
Figure 4.8: Predicted Future Air Force Pilot Attrition, by Aircraft Community



Active Duty Air Force Pilot Inventory Versus Requirements

In looking at the projected inventory and requirements for fighter and mobility pilots, a few things are clear. First, mobility pilots are projected to have a surplus, and fighter pilots are projected to have a shortage (Figure 4.9). Second, the attrition of a mobility pilot may not have the same consequences as the attrition of a fighter pilot. While it is true that mobility pilots can help alleviate some of the pressures experienced in a fighter pilot shortage—by staffing nonflying billets or taking on other rated jobs, thereby freeing up fighter pilots to take on more critical tasks—efforts to reduce attrition may be put to best use by focusing on fighter pilots first.

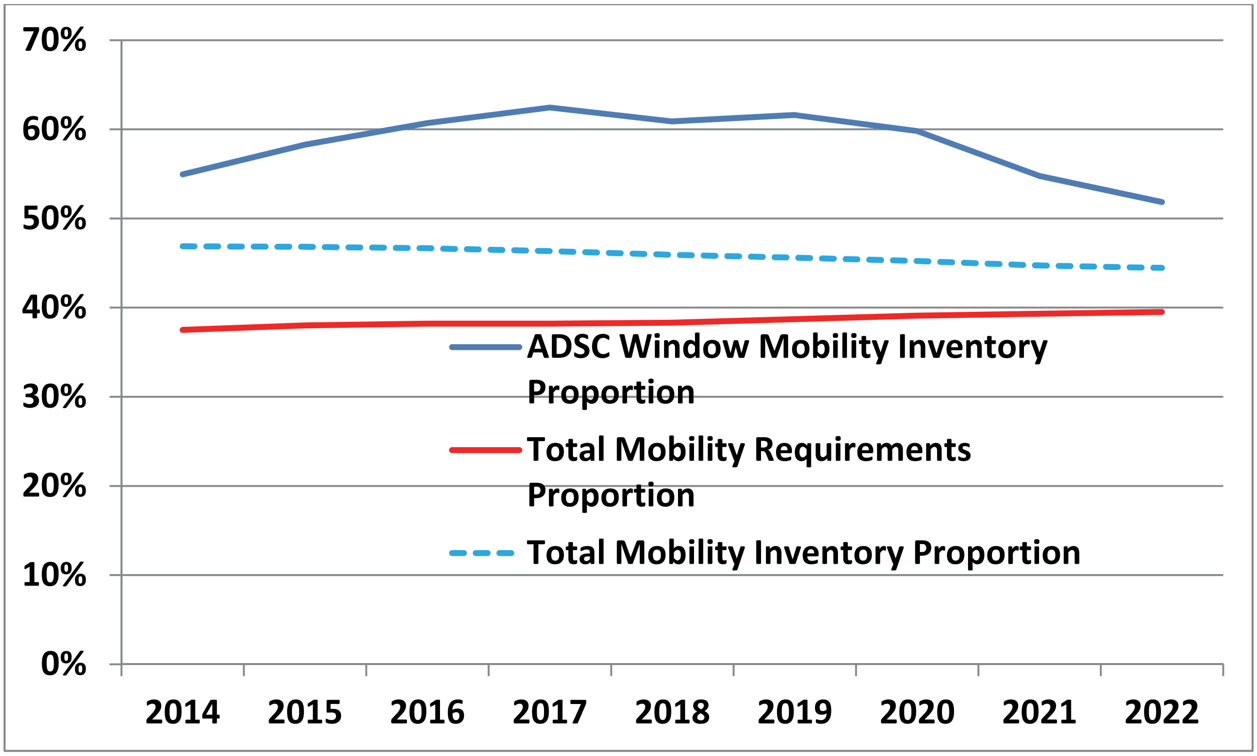
Figure 4.9: Estimated Future Active Duty Air Force Mobility and Fighter Pilot Annual Manpower Balance



Source: Bigelow, 2013a; Bigelow, 2013b; Bigelow, 2014.
Note: Not including unmanned aircraft pilots.

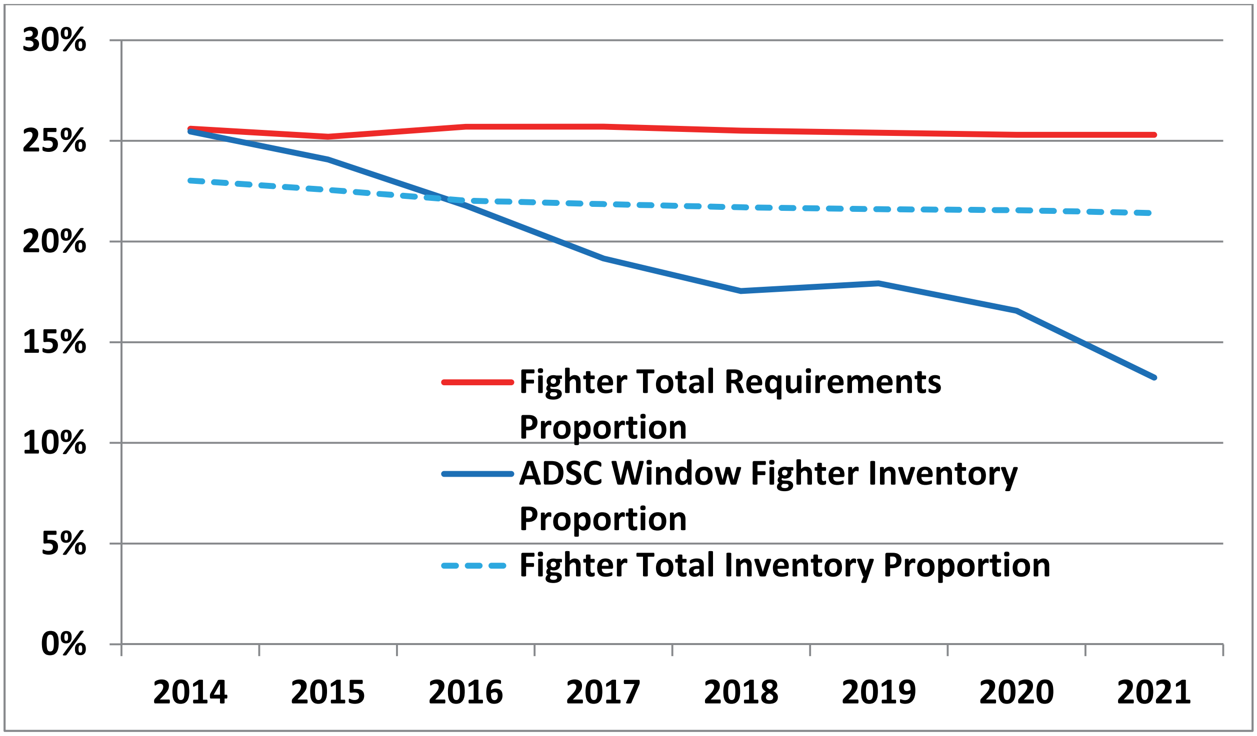
It is not possible to show the effect that attrition on pilots within their ADSC window has on overall inventory or requirements. However, Figure 4.10 does show proportions of mobility pilots as part of the total active duty rated pilot force. The total requirements and inventory proportions are determined from the total active duty requirements and inventory numbers. In comparison to these proportions, the proportion of mobility pilots within their ADSC window is well above the total requirements and inventory proportions. While it is hard to draw conclusions from this incomplete picture, it does suggest that the Air Force might be able to let mobility pilots in their ADSC windows leave active duty without adversely affecting the active duty inventory and requirements balance.

Figure 4.10: Estimated Future Active Duty Air Force Mobility Pilot Annual Manpower Balance Versus ADSC Window Inventory Proportion



The active duty fighter community, on the other hand, is projected to have a pilot shortage. Moreover, the proportion of fighter pilots in their ADSC window is expected to plummet over the next six or so years (Figure 4.11). This suggests that the Air Force might benefit from focusing on retaining more active duty fighter pilots in their ADSC window.

Figure 4.11: Estimated Future Active Duty Air Force Fighter Pilot Annual Manpower Balance Versus ADSC Window Inventory Proportion



Note: Does not include unmanned aircraft pilots.

Policy Recommendations

While there are many policy options at the Air Force's disposal that can potentially affect pilot attrition, the two that are most readily analyzed given the present model involve changing the ACIP or ACP for pilots within the ADSC window.[19] Additionally, changing these two monetary incentives might be a more politically feasible option compared to other options. For pilots in an ADSC window, the ACIP has not changed in nominal value since 1987, when it increased from $400 per month to $650 per month for pilots with 6–13 YAS. As previously discussed, inflation has drastically eroded the real value of the ACIP for this YAS group. In fact, that $650 monthly payment is currently worth about 48 percent of its real value in 1987. ACP has also changed

[19] From a cursory look, it may seem that periods with increased ACIP or ACP were followed by dips in the bonus take rate or retention rate. However, it should be mentioned that the ACIP and ACP were often increased preemptively to help slow the decrease in the take rate and retention rate in response to factors the AF predicted would contribute to fewer pilots taking the bonus and more pilots exiting the force. While this gives the appearance that the ACIP and ACP were not effective (since they were proceeded by drops in take rates and retention rates) it does not tell the full story. What I hope to have done in my model is to have captured more of the full story, where what seems likely to have happened is that increases in the ACIP and ACP contributed to higher retention than otherwise might have occurred.

considerably throughout the years. Some of the policy options available include increasing the yearly value or making a 50 percent up-front lump-sum option available.

Figure 4.12 shows the effect of indexing ACIP to inflation (an assumed 2.5 percent per year). Under the status quo, the ACIP erodes in real value by 2.5 percent each year, while the option of indexing the ACIP to inflation maintains the real value at around $464 (in 1999 dollars) for each year. The difference in value is compounded over time, so the effect of the option on attrition is compounded over time: Initially the difference between the two options is negligible, but by 2020 the difference is 39 fewer pilots leaving active duty that year.

Figure 4.12: Predicted Future Air Force Pilot Attrition Under Status Quo and Inflation-Adjusted ACIP Scenarios

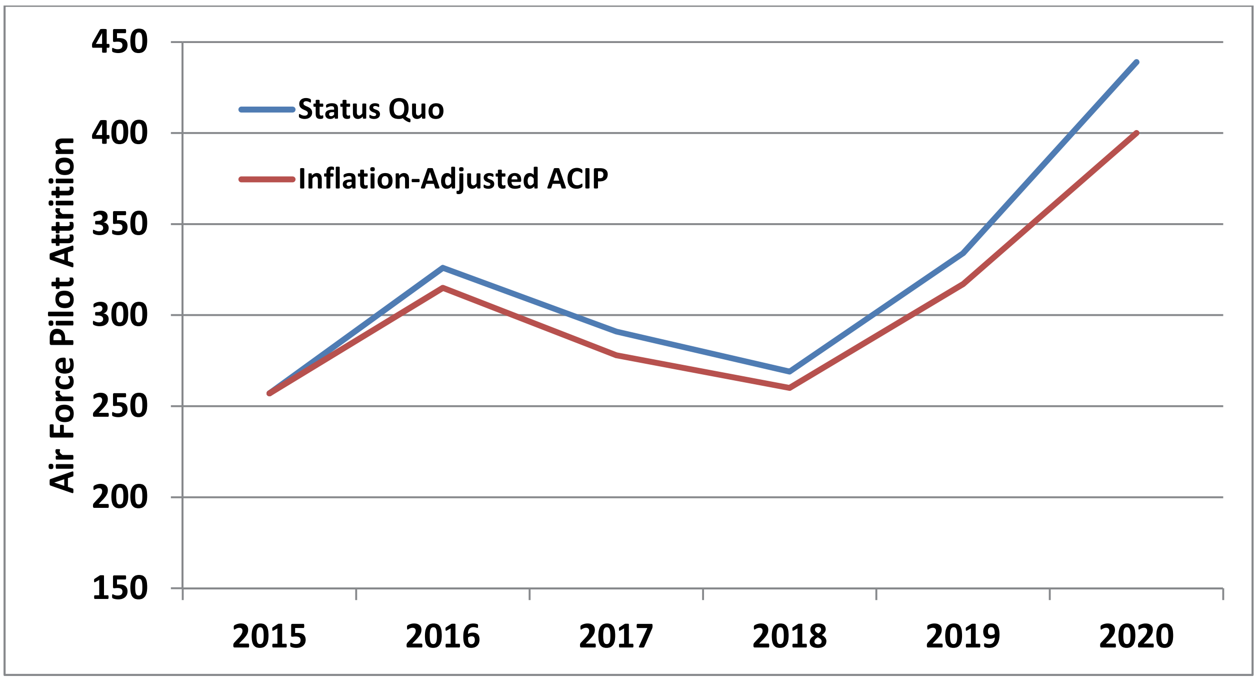
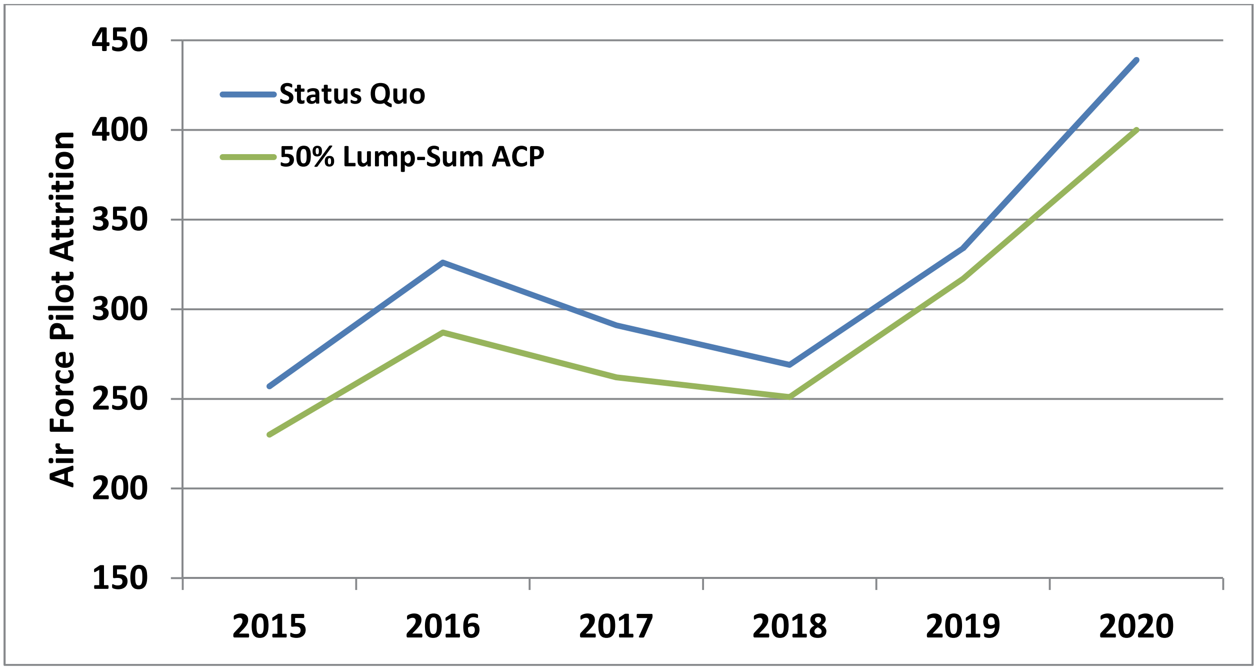


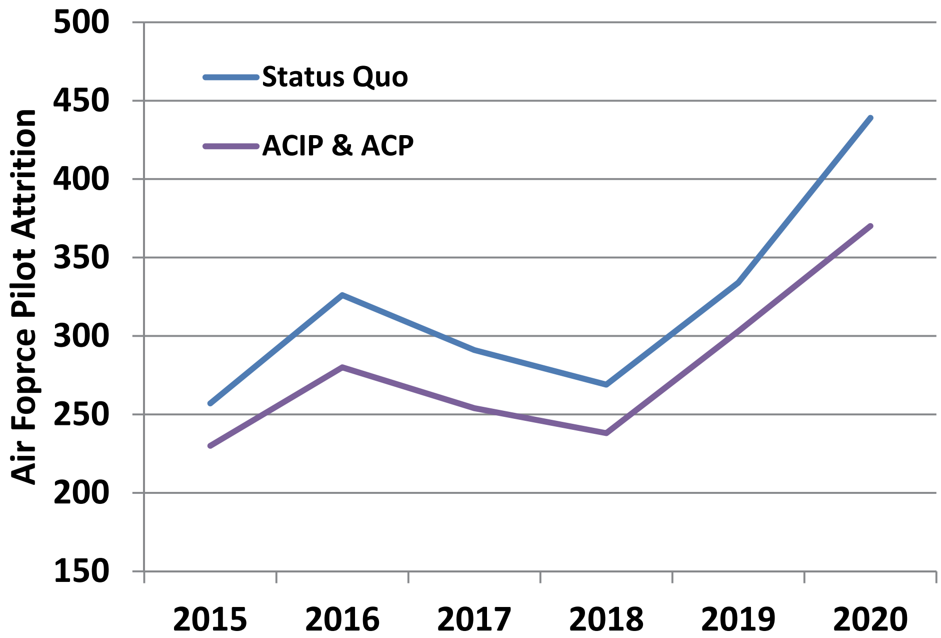
Figure 4.13 shows what is predicted to happen given the Air Force offering a 50 percent up-front lump-sum option of its $25,000 per year five-year ACP. This option effectively shifts the attrition profile downward, as each year the marginal real-valued proportion between the two options is of the same magnitude. However, the absolute effect of both options is attenuated over time, since both are eroding with inflation at the same rate. Thus, each option's effect on attrition becomes marginally smaller each year, but in a compounding manner.

Figure 4.13: Predicted Future Air Force Pilot Attrition Under Status Quo and 50 Percent Lump-Sum Up-Front ACP Scenarios



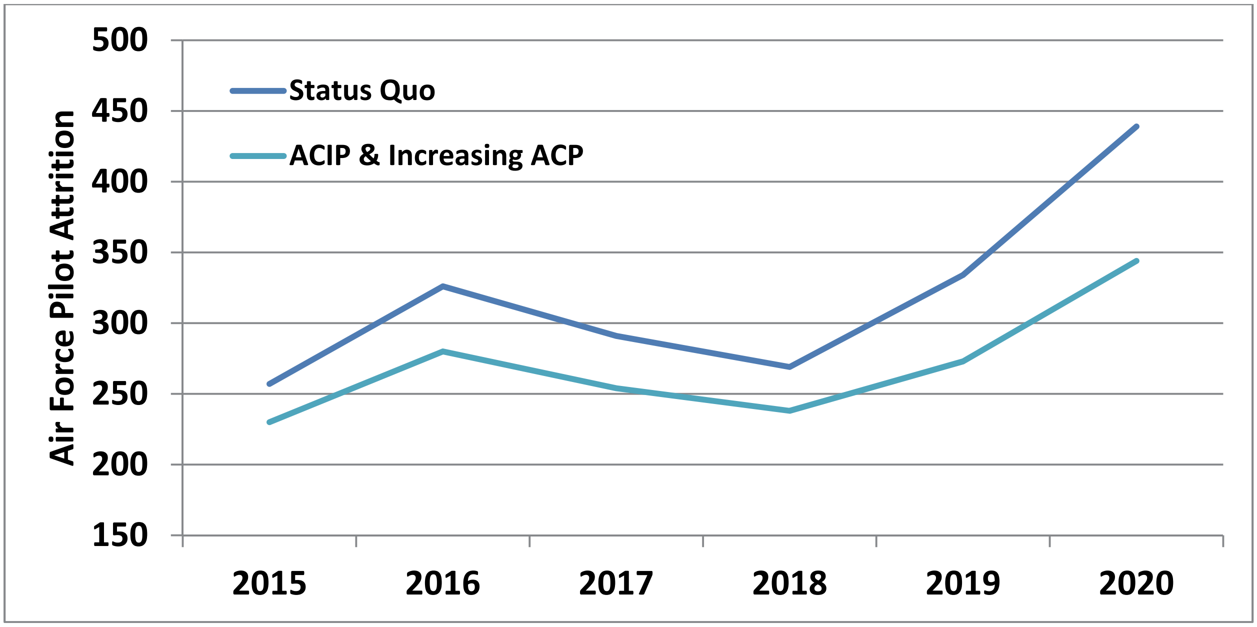
The Air Force can achieve more consistent attrition decreases from year-to-year if it does both (Figure 4.14). That is, implement both a non-eroding ACIP and a 50 percent lump-sum ACP option to achieve a more uniform decrease in attrition numbers each year. This decreases attrition by an expected 30–40 pilots per year from 2015 to 2019, and in 2020 decreases attrition by almost 70 pilots. However, since attrition begins to rise more aggressively in 2019 and 2020, the Air Force may be inclined to have a different roadmap going forward.

Figure 4.14: Predicted Future Air Force Pilot Attrition Under Status Quo and Both ACIP and ACP Adjustment Scenarios



If the Air Force wishes to address the increasing attrition past 2018, it may do well to increase the ACP yearly value to $30,000 per year in addition to keeping the 50 percent lump-sum option available (Figure 4.15). If this is accomplished near the end of FY2018, then pilots in 2019 and 2020 are even less likely to leave as compared with other cases. To break down this policy option: The Air Force institutes a non-eroding ACIP which helps keep long-term attrition in check. By instituting a lump-sum ACP option, it helps ensure that attrition each year, including in the immediate future, will be lessened. Finally, by periodically increasing the ACP, in this instance to $30,000 per year by 2018, it helps combat long-term pilot attrition by addressing the attenuation of the ACP value over time.

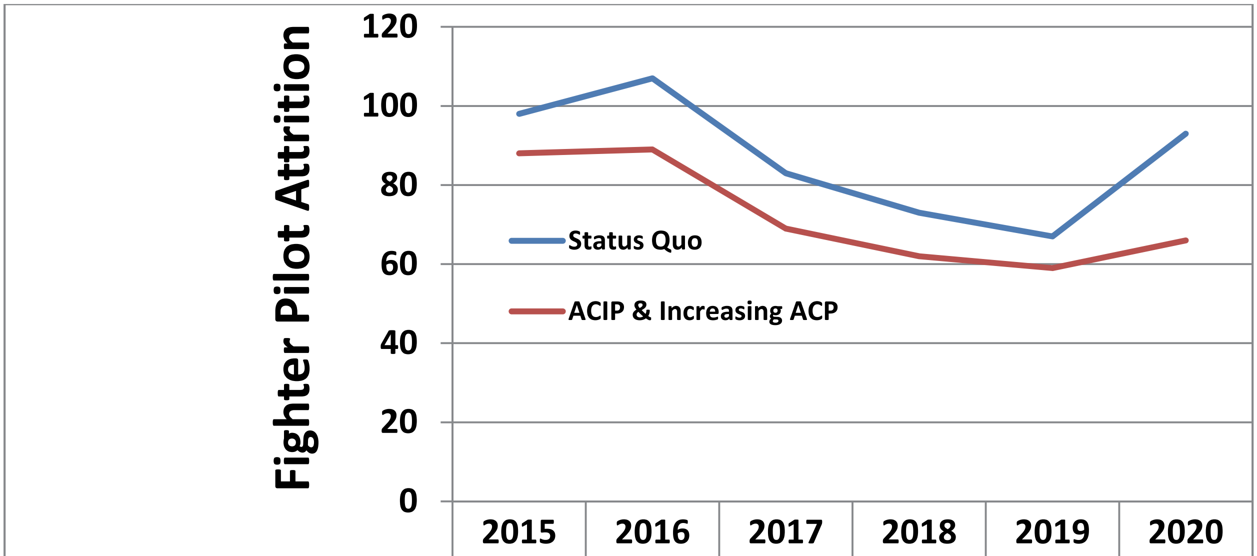
Figure 4.15: Predicted Future Air Force Pilot Attrition Under Status Quo and Both ACIP and Increased ACP Adjustment Scenarios



The Air Force has increased the ACP in recent memory. It increased the nominal yearly ACP value in FY1998 in response to increased attrition, and then again in FY2000 as it continued to try to decrease attrition numbers. Those years found the Air Force in the midst of a major airline hiring deluge, and the looming increase in hires facing the Air Force today and into the future might warrant another increase in the nominal yearly ACP value.

Specifically, we can show the impact of this last set of policy options on fighter pilot attrition (Figure 4.16). Those options are predicted to save an additional 88 fighter pilots over the years 2015–2020. Coincidentally, pilots that left one year under the status quo but stayed under these new options also stayed through the remaining years of their ADSC window. For fighter pilots, the benefit of enacting these policy options is an additional 88 pilots retained that otherwise may have left active duty. This begs the question, at what cost?

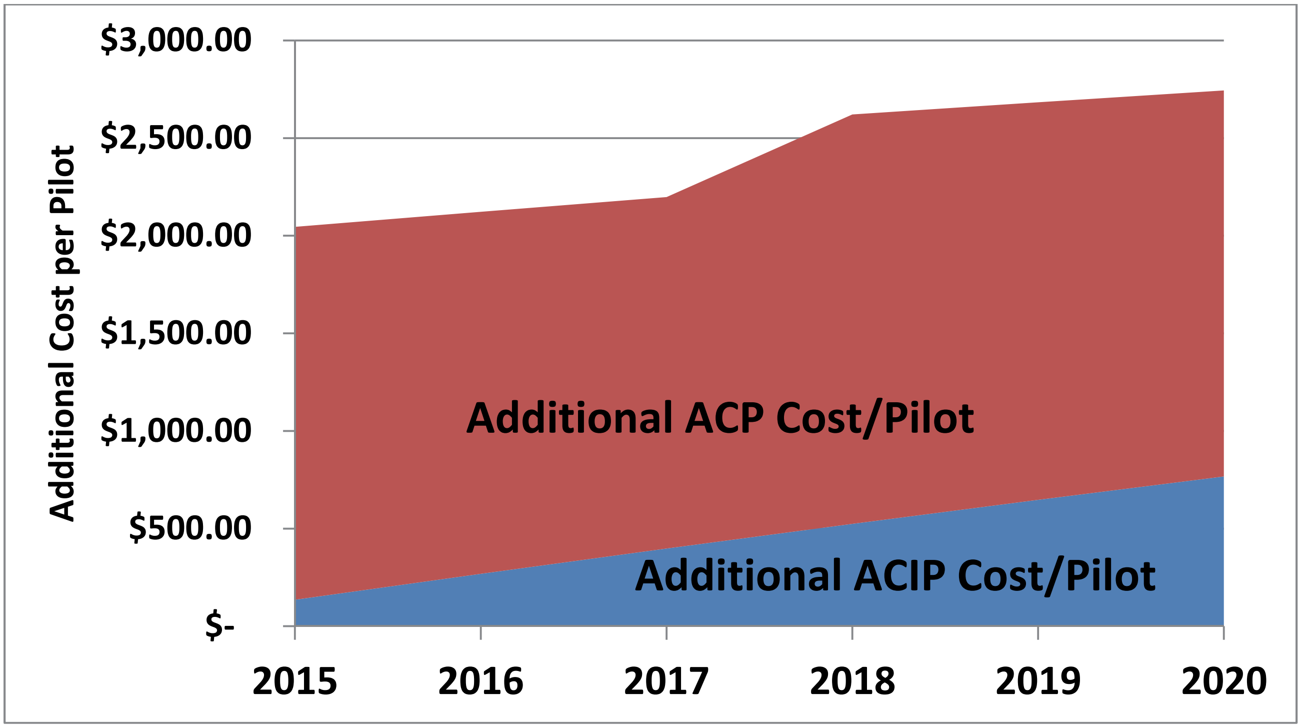
Figure 4.16: Predicted Future Air Force Fighter Pilot Attrition Under Status Quo and Both ACIP and Increased ACP Adjustment Scenarios



	2015	2016	2017	2018	2019	2020
Status Quo	98	107	83	73	67	93
ACIP & Increasing ACP	88	89	69	62	59	66

Figure 4.17 shows the cost in 1999 dollars per pilot for each year of the increased ACIP and ACP. The non-eroding ACIP costs about \$135 extra in 2015 per pilot, and grows to cost about \$767 extra in 2020 per pilot. The ACP policy option costs about \$1,900 extra in 2015 per pilot, decreases to about \$1,800 extra in 2017 per pilot, then increases to about \$2,100 extra in 2018 per pilot before decreasing to about \$2,000 extra per pilot in 2020.

Figure 4.17: Predicted Future Cost per Pilot of Both ACIP and Increased ACP Adjustments



Clearly, the ACIP option is the least costly of the options per pilot. Traditionally, ACIP changes have been applied Air Force–wide, regardless of the type of aircraft flown. Thus, if this option is to be used, it is probably going to be applied Air Force–wide to all eligible active duty pilots. The ACP, on the other hand, which is the more expensive of the two options per pilot, has in the past been changed to target specific groups of pilots. For example, in 2013 the Air Force targeted only the fighter community with a $25,000 per year nine-year 50 percent lump-sum ACP option (Jeff Schogol, 2013).

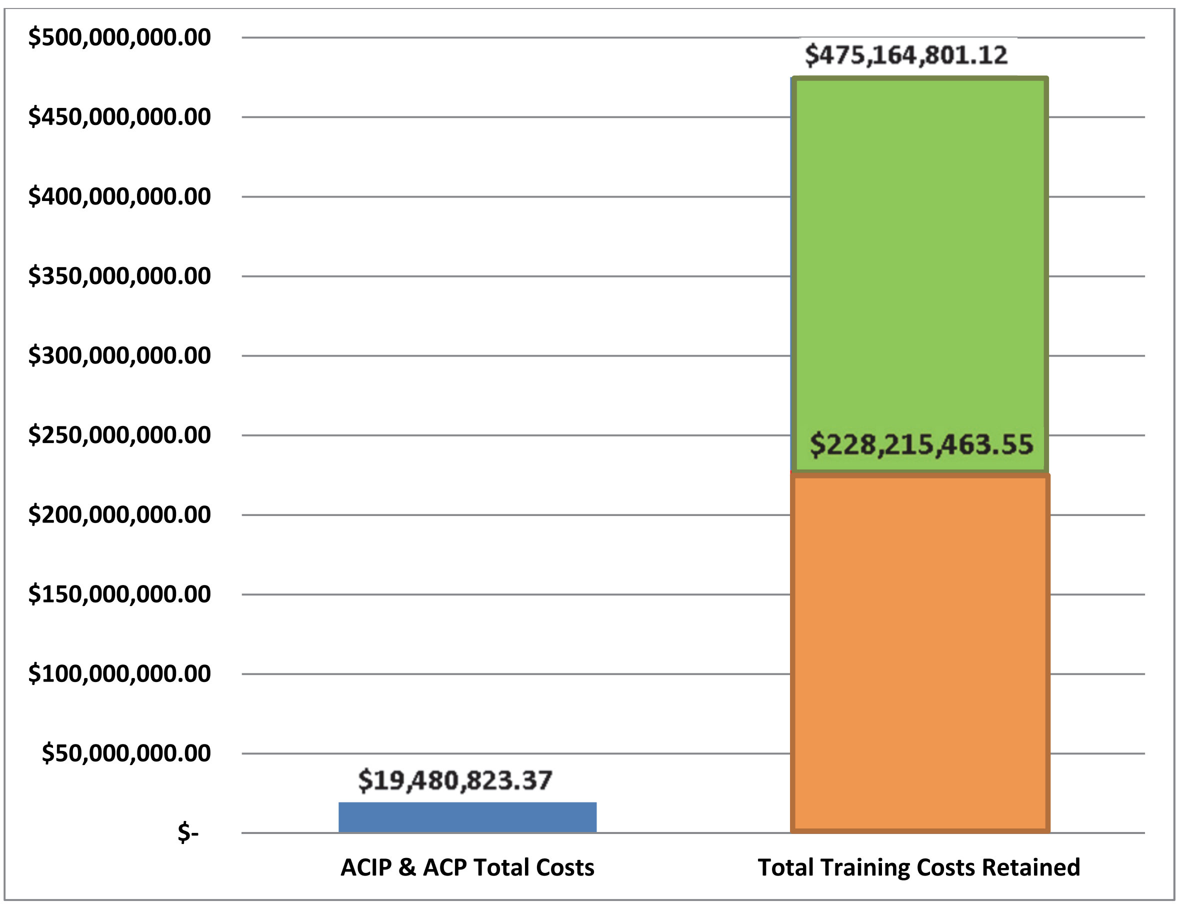
It seems relatively clear, then, that one potential policy avenue involves indexing the ACIP to inflation for all active duty pilots 6–13 YAS, and then offering fighter pilots a lump-sum ACP option that increases to $30,000 per year in 2018.

Choosing this policy costs about $300,000 in increased ACP costs for 2015–2020, about $19.2 million in increased ACIP costs (assuming approximately 7,000 total active duty pilots each year have 6–13 YAS) (Figure 4.18). However, what it gains the Air Force is 88 additional fighter pilots retained. To estimate the benefit, I use estimates based on F-16 training costs. In 2013, the average cost of training each F-16 pilot was about $5.4 million in 1999 dollars.[20] This

[20] This cost estimate includes variable and fixed instructor costs, school overhead costs, dormitory support (if applicable), maintenance (aircraft/training equipment), real property maintenance support, medical, other Base Operating Support (BOS) costs (i.e., comptroller, transportation, grounds maintenance, custodial), student costs and flying related costs (i.e., fuel, depot level reparables, CLS, etc.) all for a fighter/bomber UPT track, Introduction to Fighter Fundamentals Course, and the F-16 Basic Course (AFI 65-503, 2013a). This average/total cost includes a portion of Headquarters support costs.

serves as an estimated upper bound to the benefit, and equates to about $475 million in 1999 dollars in training costs retained (as an opportunity cost). The variable cost of training each F-16 pilot in 2013 was about $2.6 million in 1999 dollars (AFI 65-503, 2013b). When multiplied by all 88 pilots retained, this equates to an opportunity cost retained (via training costs retained) of about $228 million in 1999 dollars. Since this estimate does not include any fixed costs, this will serve as an estimated lower bound to the benefit of retaining those 88 additional fighter pilots. Thus, as a recommendation based on the benefit to the fighter community alone, this dissertation recommends (1) indexing the ACIP to inflation for active duty pilots with 6–13 YAS and (2) targeting the fighter community with a lump-sum ACP option that increases to a $30,000 per year option in 2018. Doing so retains between a quarter-, and a half-billion dollars (in 1999 dollars) in estimated training costs. Figure 4.18 below compares and contrasts the total ACIP and ACP costs to the estimated lower and upper bounds of retained training costs.

Figure 4.18: Total Costs of ACIP and Increased ACP Adjustments Versus Retained Training Costs (as Opportunity Costs), 2015–2020



Chapter Five: Conclusions

This dissertation focused on active duty Air Force pilots in the first three years following completion of their initial ADSC (and also disregarded pilots with greater than 20 YOS). In researching pilot attrition since the Vietnam War, two possible trends and attrition influencers surfaced. First, in periods of increased major airline hiring, active duty Air Force pilot attrition increased. Second, pilots' experiences and expectations placed pressure on them to stay or leave. It is possible that major airline hiring simply acted as an escape valve.

In testing these assumptions and looking for ways to better predict pilot attrition into the future, changes in major airline hiring had palpable effects on a pilot's odds of leaving active duty. While the extent of this effect depended on the type of aircraft the pilot flew, the direction of the effect remained consistent across RDTM categories. Major airline hires were statistically significant predictors at the 1 percent level for fighter pilots, bomber pilots, mobility pilots, and pilots in the "Other" category. In ranking the effect of major airline hires on pilot attrition, pilots in the "Other" category were most sensitive to major airline hires, followed by mobility pilots, then fighter pilots, then bomber pilots. Although CSAR pilot attrition was positively impacted by increases in major airline hires, the result was not statistically significant.

Annual pilot attrition numbers for the years 2015–2020 are likely to remain above the average annual pilot attrition numbers observed in years 2002–2012. While mobility pilots are likely to account for the greatest share of pilot attrition, the community on the whole has a surplus of pilots and is better suited than other communities to endure the predicted attrition within its ranks. The fighter community, on the other hand, is already projected to have a pilot shortage into the foreseeable future and is least suited of all communities to bear the numbers of its pilots being predicted to leave.

For these reasons, this dissertation recommends re-instituting the 50 percent ACP lump-sum option and increasing the value to $30,000 per year in 2018 for fighter pilots in their ADSC window. Additionally, it is recommended that the Air Force index the ACIP to inflation for at least the active duty pilots with 6–13 YAS. Enacting both measures would be greatly cost-effective in terms of the training costs retained, and doing so would help lower pilot attrition in all communities, and especially in the fighter community.

Future Areas for Study and Parting Thoughts

Although many pilots and surveys mentioned quality-of-life factors as hugely influential on the attrition decision, I was not able to test these types of factors as feasible policy recommendations, since they are difficult to model. From a logistic regression modeling perspective, monetary incentives are more readily testable. Other things affecting pilots, such as

their duty location, their commander(s), and their family's wellness, are inherently more challenging to include in a quantitative model. These are areas that future research might be better poised to explore in search of additional policy guidance. Future research might also look into ways of ensuring that pilots get more of the types of flying hours that they seem to enjoy. Better data on TDYs, deployments, and even retirement changes may help future research and analysis improve on the results reached in this dissertation. Lastly, the DoD has occasionally conducted Aviator Surveys whenever it is concerned that pilot attrition may rise to unhealthy levels. It may be in the Air Force's best interest to conduct these surveys annually for its own aviators. Doing so may reveal new issues impacting pilot attrition, may unearth leading indicators for pilot attrition, and also may give the Air Force a better understanding on how to better influence pilot attrition.

It is also worth mentioning that this dissertation looks at pilot attrition from the perspective of the Active Duty Air Force. While active duty pilot attrition may be bad for the Active Duty Air Force, the Air Force as a whole may prefer active duty pilot attrition in some years since that is a source that replenishes its pilot inventory in the Reserve or Guard components. This may be especially relevant given the number of Reserve pilots that are rumored to be retiring in the next few years.

Appendix A: Other Specifications

Pay Streams

Past studies have relied on present discounted values (PDV) of the remaining career earnings facing pilots for either staying in the Air Force or joining a major airline. I calculated two possible pay streams for each pilot. Option 1 is the case where the pilot stays on active duty. It assumes the pilot will stay until 20 YOS before attempting to join the airlines. Option 2 is the case where the pilot immediately leaves active duty in the hopes of landing a major airline position. I used pay rates and other relevant information that would have been available to pilots at the time of their decision. For example, I assumed that pilots internalized the legal retirement age at the time, not the one they would end up retiring at. This is important because the mandatory major airline pilot retirement age recently changed from 60 to 65 years of age. Pilots could not update their expectation based on information they did not have at the time.

In calculating pay stream PDVs, I assumed a 10 percent discount rate. I assumed that the probability of being hired by a major airline depended on the number of hires made in any given year. I assumed a 5 percent probability in 2009 (only 30 total major airline pilots hired), and an 85 percent probability in 2000 (5,105 major airline pilots were hired). I linearly interpolated the probabilities for the remaining years. I assumed that pilots not hired by the major airlines immediately found work at regional airlines, and that the probability of being hired by a major airline after working in the regional airlines for five years was 75 percent. The remaining 25 percent of pilots continued to work at regional airlines until retirement.

For the Air Force pay stream, I included base pay, basic allowance for housing (BAH), basic allowance for subsistence (BAS); cost of living allowance (COLA); ACIP; ACP; tax advantages from BAH, BAS, and COLA; and the retirement pension. I assumed that pilots expected the increase in future pay associated with higher rank and seniority to match the inflation rate. This allowed me to use the pay table for the current decision year, along with the expected ranks achieved at each YOS, to calculate the future pay stream for this component. I calculated BAH, BAS, and, COLA by calculating a weighted average for each year-YOS for eligible pilots (where the calculated amounts depended on the individual's marital status). I then assumed the real values would keep pace with inflation.

In calculating ACIP, I assumed that pilots expected the nominal value to increase every seven years, and linearly extrapolated the increased nominal values at each YAS from the changes since 1979. For ACP, I assumed pilots would take the ACP with the highest PDV available. I also calculated the tax advantage conferred on each pilot, since BAH, BAS, and COLA are not taxed. Lastly, I assumed pilots would avail themselves the retirement option with

the highest PDV. I multiplied the retirement stream by the probability of survival in the decision year for each older age (until 100 years of age).

For the airlines, I assumed that the salary progression followed each year's average salaries as reported by FAPA.aero. I also assumed pilots took the "B Fund" retirement package, where I assumed an investment rate at 11 percent of annual earnings and an 8 percent accrual rate that was offered as a lump sum to pilots at their retirement age.

It should be noted that the pay stream covariates produced neither good variation nor significant covariate results in the model.

Other Models Considered

The other most significant model formulation attempted broke up the pilot's attrition decision into two steps. In the first stage, the pilot decided whether or not to take the ACP if it was offered to them. In the second stage, the pilots who did not accept an additional commitment would then decide whether or not to leave active duty. This setup was complicated, and in developing both stages, I arrived at a model where the first- and second-stage designs were very similar to one another. I then made them identical, and suffered no statistical loss in predictive capabilities. This prompted me to return to a one-stage formulation of simply predicting attrition, agnostic to which pilots had already accepted the bonus and thus would be ineligible to leave active duty. This simplified model did not appear to lose anything compared with the two-model formulation.

Other Variables Considered

I wanted to somehow capture the effect of peer or social pressure on a pilot's attrition decision. For that reason, I investigated the impact the previous year's and the current year's retention rates had on the outcome. I then discarded this variable because it appeared to soak up some of the effect from other variables. Additionally, it is a source of endogeneity.

I also wanted to encapsulate the fact that the effect of major airline hiring on active duty Air Force pilot attrition also depends on the number of civilian pilots eligible to be hired. For example, a pilot's decision to leave the Air Force might differ if there are only 100 other civilian pilots eligible to be hired by the airlines versus 10,000 civilian pilots waiting to be hired. I did this by first calculating the total number of pilot hires made by all airlines, regional and major. Then I calculated each year's ten-year average, using the ten previous years of hiring. Lastly, I used the difference in each year's actual hiring numbers and the ten-year average to compute a measurement for the "hiring surge." This surge might stand as a proxy for the number of civilian pilots eligible to be hired. The thought is that the civilian training base will respond to changes in long-term hiring demand, but might not be able to respond fast enough to fill the airlines' coffers during hiring surges. Thus, there are years with positive surges and years with negative surges.

Appendix B: Instrumental Variable

In developing an instrumental variable (IV), I used six regressors in the first-stage equation to predict major airline hires. The first regressor is the yearly total number of U.S. air carrier flying operations (number of flights) ("Research and Innovative Technology Administration," 2014). The second is the percentage change in the Europe Brent Spot Price FOB (dollars per barrel) from the past year (U.S. Energy Information Administration, 2014). The third is the total U.S. air carrier annual profit or loss % change ("Research and Innovative Technology Administration," 2014). The fourth is the U.S. GDP annual growth rate (U.S. Bureau of Economic Analysis). The fifth is the passenger airline annual net profit margin (Dempsey, 2008; CAPA Centre for Aviation, 2012; International Air Transport Association, 2013). Lastly, using data from CPS surveys, I estimated the number of airline pilot retirements in each year and used that as the sixth regressor. Figure B.1 plots the actual number of major airline hires, along with what the instrumental variable predicted. Next, I use the predicted IV values in the second-stage equation to model the effect of each of the logistic covariates on attrition (Table B.1).

Figure B.1: Actual Major Airline Hires Versus Instrumental Variable Predicted Major Airline Hires

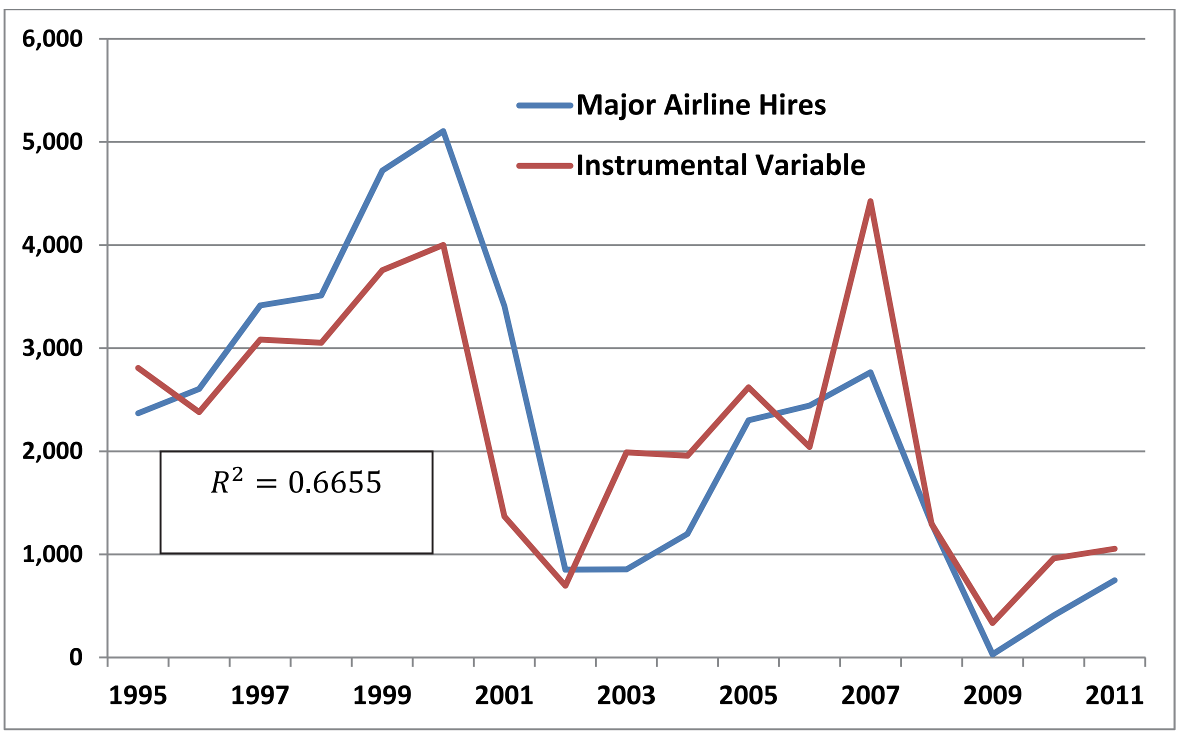


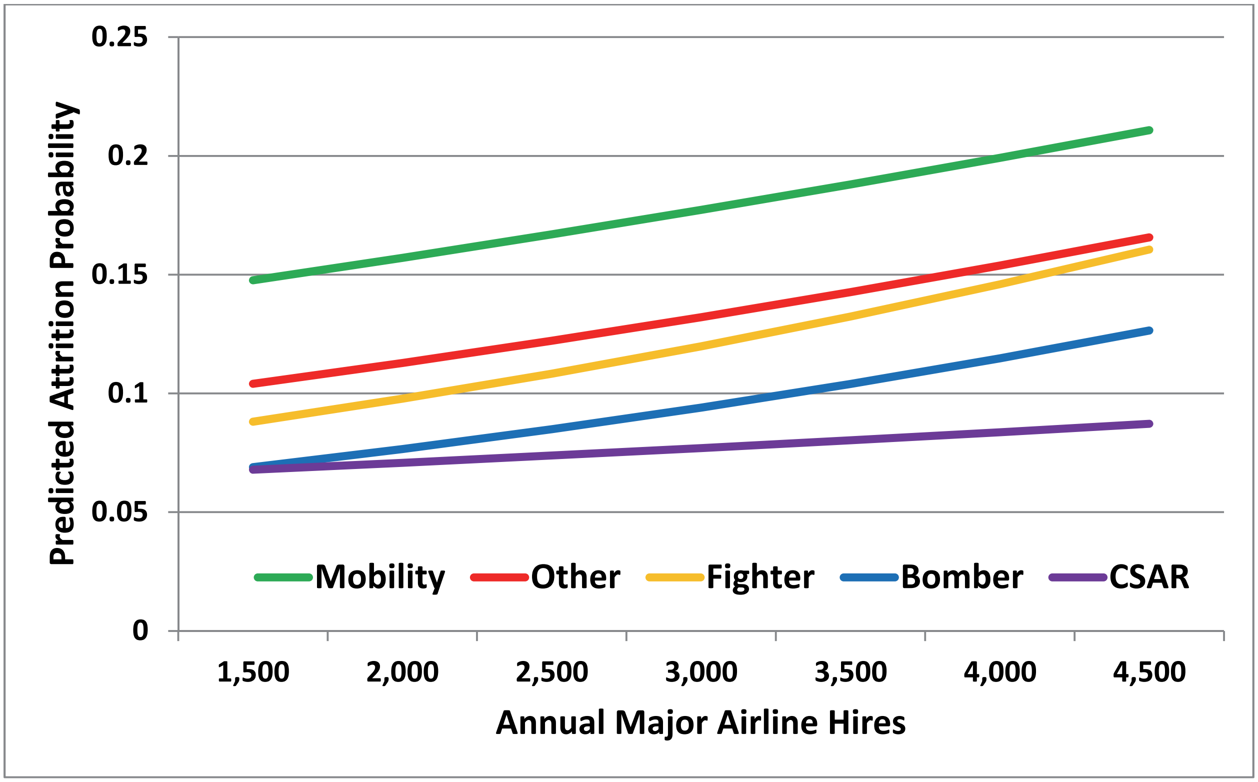
Table B.1: Logistic IV Model Odds Ratios Output

Covariates		Fighter	Bomber	Mobility	CSAR	Other
ADSC Window	Year 1	1.285277**	1.360536	1.239362**	1.711682*	0.9177062
	Year 2	0.8675405	0.7233139*	0.7144907**	0.8246131	0.4428614**
≥ 15 YOS		0.3017401*	0.4698562	0.2200647**	2.055761	1.702537
Female		1.795893**	1.968617	1.662333**	2.472899*	2.518736*
Not Married		1.332849**	1.239887	1.492972**	1.384367	2.262634**
Any Children		1.126539	0.799026	1.247218**	1.648728	1.568612
Number of Children		0.9843373	0.9916176	0.851782**	0.7143993	0.9149438
Non-White		1.07061	1.218779*	1.181215*	1.092759	0.9751359
Commissioning Source	USAFA	0.782438**	0.8185658	0.8088743**	0.9736208	0.7645636
	OTS	1.195776	1.353309*	1.228694**	0.6513066	0.9253588
YOS		0.9989434	1.005086	0.9622622	1.011124	0.9639952
<10 YOS		0.6362231**	0.685374	0.6994164**	0.8533485	0.4470155*
Any Deployments		0.5547215**	0.6711303	0.9095738	0.5375738	0.3927397**
Number of Deployments		1.252499**	0.9629406*	1.030277	1.255136	1.187836
Monthly ACIP (100s)		0.8503267**	0.819752*	0.8677997**	0.6644724**	0.8985554
Monthly Base Pay (100s)		0.8767233**	0.8936295**	0.850686**	0.859755**	0.8420272**
ACP PDV (10,000s)		0.9555875*	0.9294279*	1.026219	0.8765115	0.9444741
Over Flying Hours Threshold		1.473869**	2.015554**	2.124988**	1.152328	2.281663**
Combat Hours		0.9997869	0.9989613*	0.9987851**	0.9973296*	0.9986065**
Out of Last 4 Years, How Many Did Pilot Log <75 1st Pilot Hours	1	1.417718**	0.9719713	1.232841**	1.160063	0.9540421
	2	1.761133**	0.7851362	1.454169**	1.050396	1.268479
	3	1.851312**	1.397342	1.677176**	0.7215669	2.215476**
	4	2.406948**	0.3587329*	2.132695**	1.694069	2.830649*
CPS Yearly Wage		1.175134**	1.264226**	1.312143**	1.475021**	1.172259
Major Airline Hires (IV) (1,000s)		1.265475**	1.268467**	1.174419**	1.102454	1.220294**
Monthly Major Airline Salary (1,000s)		0.9470356	1.022011	0.861041**	0.7649737*	0.7867845**
Pseudo-R^2		0.0595	0.0985	0.1259	0.1096	0.1399

Notes: Odds ratios are reported. Model uses robust standard errors. Dependent variable=0 if pilot is present in active duty personnel file in the following year, =1 otherwise. All monetary values have been normalized to 1999 constant dollars. See text for definitions of variables.
* Denotes significance at the 5 % level.
** Denotes significance at the 1% level.

These results are overall consistent with the original model. However, many of the covariates experience a loss in statistical significance. Additionally, pilots now appear to be somewhat less sensitive to major airline hires—as the IV—in affecting their predicted probability of attrition.

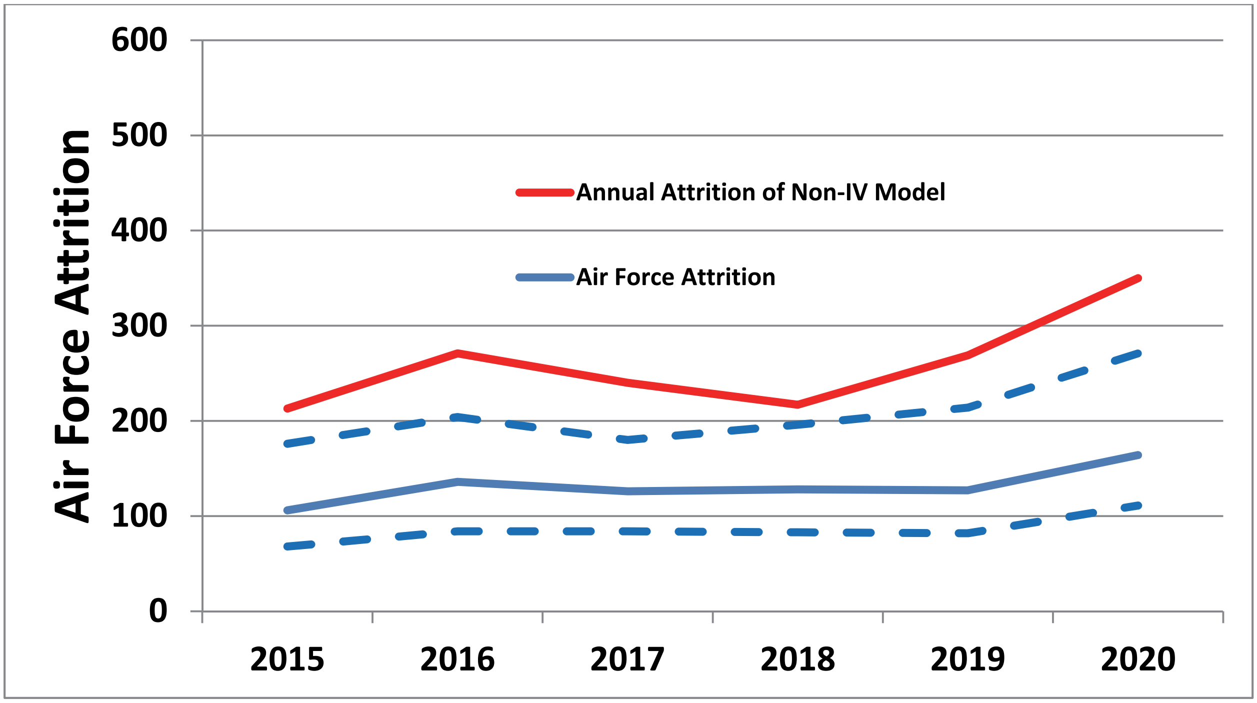
Figure B.2: Logistic Model Odds Ratios Output



While the order of the aircraft types remains consistent in their predicted probability of attrition over annual major airline hires, their sensitivities to the IV are overall decreased compared with the original model. With this decrease in sensitivity to major airline hiring variation, the impact of the looming increase in major airline hiring is not as pronounced in the IV model as compared with the non-IV model.

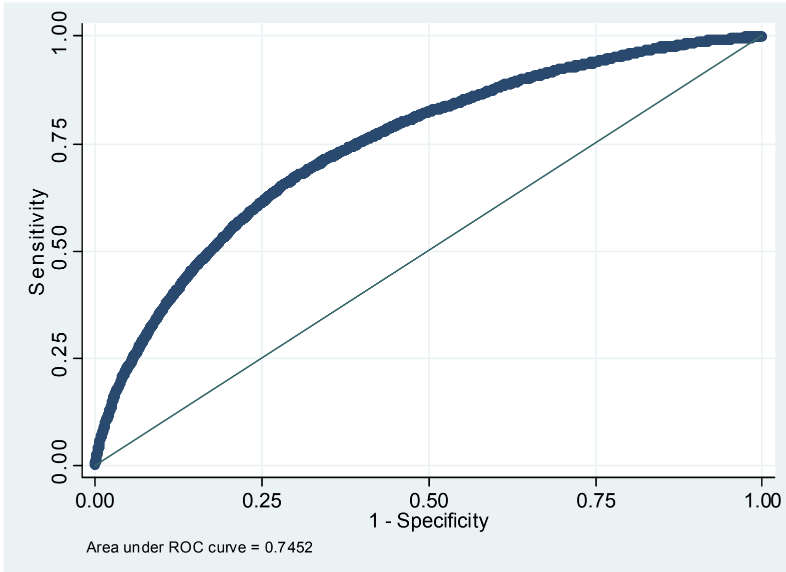
The IV model underpredicts future attrition as compared with the original model, which does not use an instrumental variable for major airline pilot hiring. In this prediction, future Air Force pilot attrition is essentially a continuation of the average attrition from 2002 to 2012, even though major airline pilot hiring is expected to greatly increase (Figure B.3). This warrants further investigation into how well the IV model is calibrated and cross-validated.

Figure B.3: Predicted Future Air Force Pilot Attrition with 95% Confidence Bounds for IV Model



Again, the area under the curve (0.7452) reveals that the model does a fair job at discriminating between attrition and retention, although this AUC is slightly less than the original model's AUC (Figure B.4). In doing the cross-validation, the fitted value approaches 0.745153. Thus the non-naïve estimate shows that the IV model still does a fair job at discriminating.

Figure B.4: Initial IV ROC-Curve



The 100 simulation-folds reveal that the IV model on average has a calibration ration of very close to 1 (Figure B.5). However, the median ratio is slightly less than 1. In predicting pilot attrition from 1996 to 2011, Figure B.6 shows that in periods of higher airline hiring the IV model tends to underpredict attrition. This may be precisely what will happen in the future. The IV model is less sensitive to airline hiring, and thus may underpredict the impact of increasing airline hiring on active duty Air Force pilot attrition. This difference is especially pronounced as hiring increases further and further above the average hiring witnessed in the recent past. In general, the model this dissertation relies on appears to track with the actual Air Force pilot attrition better than the IV model. However, the difference does not appear to be that great, relatively, and this may warrant further investigation in future studies.

Figure B.5: IV Model Calibration Ratios Histogram

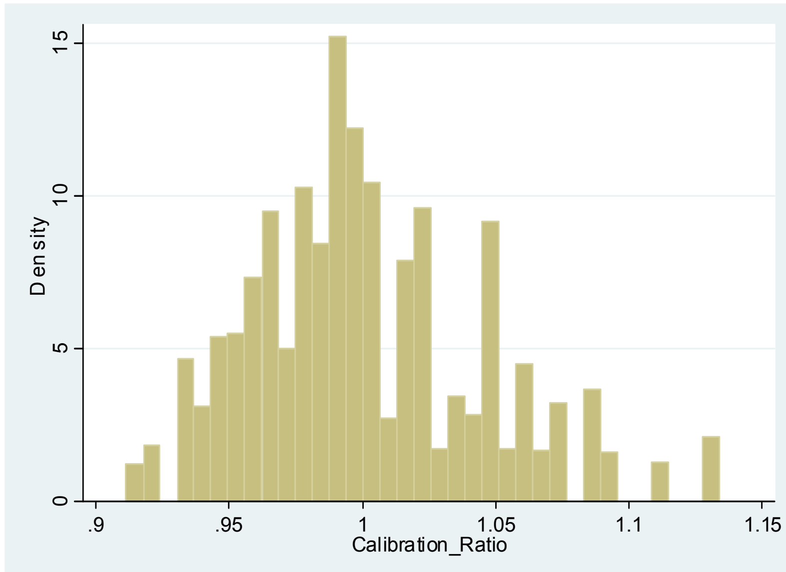
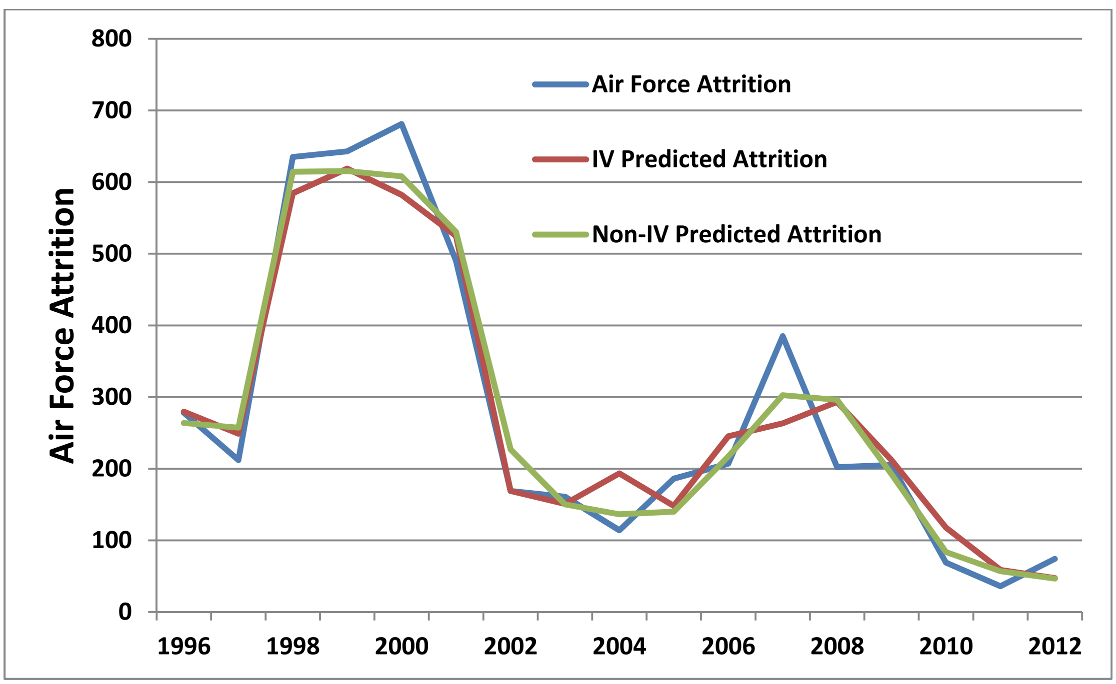


Figure B.6: Predicted Attrition Comparison, 1996–2011



Appendix C: Variable Description

The outcome variable in this model is attrition.

ADSC_Window

"ADSC_Window" gives the number of years after the completion of an individual's initial ADSC. It varies in value from 0–2 for the data included in this study.

Retire_Within_Five_Years

"Retire_Within_Five_Years" is an indicator variable. It has a value of 1 if the individual has between 15–19 YOS. It is 0 elsewise.

Female

"Female" is an indicator variable. It has a value of 1 if the individual is female and 0 if the individual is male.

Not_Married

"Not_Married" is an indicator variable. It has a value of 1 if the individual is not married and 0 if he or she is married.

Children

"Children" is an indicator variable. It has a value of 1 if the individual has any children and 0 if he or she does not have any children.

N_Children

"N_Children" is intended to return the number of children the individual has. It takes the total number of dependents the individual has in their household, and subtracts by the individual's marital status. For example, if an individual has three dependents and is married, then "N_Children" will be two.

Non_White

"Non_White" is an indicator variable. It has a value of 1 if the individual is not white and 0 if he or she is white.

Commissioning_Source

"Commissioning_Source" is a categorical variable. It has a value of 0 if the individual commissioned via Reserve Officers' Training Corps (ROTC), 1 if they commissioned from the United States Air Force Academy (USAFA), and 2 elsewise.

YOS

"YOS" gives the individual's years of service.

YOS_Young

"YOS_Young" is an indicator variable. It has a value of 1 if the individual has less than 10 YOS.

Deployment

"Deployment" is an indicator variable. It has a value of 1 if the individual has ever been deployed and 0 elsewise.

Deployment_n

"Deployment_n" gives the individual's total number of deployments to date.

Hundred_Base_Pay99

"Hundred_Base_Pay99" is the individual's monthly base pay in hundreds of 1999 constant dollars.

Hundred_ACIP99

"Hundred_ACIP99" is the individual's monthly ACIP pay in hundreds of 1999 constant dollars.

Ten_Thousand_ACP_Stream99

"Ten_Thousand_ACP_Stream99" is the present discounted value (PDV) of the fiscal year's 5-year Aviator Continuation Pay (ACP) being offered to pilots in ten-thousands of 1999 constant dollars. This calculation assumes individuals will take the 50 percent lump-sum option if available, and that individuals have a discount rate of 10 percent.

Flying_Hours_Bin

"Flying_Hours_Bin" is variable indicating whether or not a pilot had more than a certain number of career flying hours. This variable is 1 for fighter pilots with greater than 2,000 career flying hours,1 for bomber pilots with greater than 2,200 career flying hours, 1 for mobility pilots with greater than 2,400 hours, 1 for CSAR pilots with greater than 2,000 hours, and 1 for all other pilots with more than 2,100 hours. The variable is 0 for pilots under those thresholds.

Total_Combat_Hours

"Total_Combar_Hours" gives the total hours the pilot has logged as combat in their career up to and including that fiscal year.

Last4_First_Pilot_Years

"Last4_First_Pilot_Years" gives the number of years out of the past four years that the pilot logged less than 75 flying hours as a first pilot.

Thousand_CPS_Wage99

"Thousand_CPS_Wage99" is the average monthly civilian airline pilot pay in thousands of 1999 constant dollars, using the CPI, and is reported by calendar year. This average is not restricted to civilians flying major airlines, and includes all civilian airline pilot pay including regional pilot pay.

Thousand_Major_Air_Hires

"Thousand_Major_Air_Hires" is the number of pilots hired by major airlines each calendar year. This variable was reported by FAPA.aero[21].

Thousand_Major12_Salary99

[21] (Future & Active Pilot Advisors, 2013a)

"Thousand_Major12_Salary99" is the average monthly salary of a major airline senior captain with greater than 12 years in the majors. This value is in thousands of 1999 constant dollars and is reported by calendar year. The nominal value salary data is missing from years 1995–1997 and 2011. Nominal values were computed in years 1995–1997 by taking the 1998 value and dividing by an assumed 3 percent salary inflation each year going backward. The 2011 value was computed by taking the 2010 value and assuming the salary grew in nominal value by 3 percent. Then, each year was converted into 1999$ using the CPI. This variable was reported by Kit Darby Aviation Consulting.[22]

[22] (Darby, 2013a)

Appendix D: Interview Script

Hi ___, I'm doing a dissertation looking at how the looming increase in airline hires will impact Air Force pilot attrition, and the bulk of it will be in designing an econometric model to predict future attrition at the individual level.

What I'm trying to do is speak with some subject matter experts, individuals who were part of the Air Force during different times in its retention history, or who have studied historical retention, and get a sense from them of what factors contributed to pilots' decisions to stay or leave the Air Force.

First off, when did you join the Air Force, and what years were you flying active duty?

Do you recall what retention issues there were for yourself and other pilots at the time?

What factors were there influencing pilots to stay in or leave?

Is there anything else that you feel contributed to a pilot's decision?

Do you have any final questions or comments about my dissertation, or suggestions even?

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